The Glass Industry
REG. U. S. PAT. OFF.

Vol. 11 OCTOBER, 1930 No. 10

Glass Calculations Simplified

Primary Calculations Without the Use of Chemical Symbols

By R. R. SHIVELY, Ph.D.[1] and V. H. REMINGTON, M.S.[2]

Several years ago an article similar to this was published by one of the writers and judging from the number of requests for reprints, it was very popularly received. In rewriting, the paper has been greatly enlarged and in many instances, particularly in coefficient of expansion calculations, revised figures have been used.

The writers wish to impress the fact that there is nothing particularly new in this paper. Their work consists merely in arranging in an accessible way well known facts.

WITHOUT chemical knowledge of the reactions which take place when a glass batch melts, it is impossible to calculate the amount of glass resulting from a certain batch. It is also impossible to determine the loss in melting and the exact cost of the glass per pound. The purpose of this paper is to give to the practical man, having no knowledge of chemistry, data which will enable him to make these calculations.

The writers have gone further than this in giving the most reliable information available for determining coefficients of expansion which are essential in the development of cased glasses, heat resisting glasses, and glasses to be used together, such as using a stem of one glass and a bowl of another. There is also given a table from which it is possible to determine the batch required to produce a glass of certain known composition—in other words, a method of calculating the batch required to duplicate a certain analyzed glass. This table can also be used to determine the comparative fluxing value of different chemicals.

There are a few discrepancies in these tables, but the results generally obtained are as accurate as it is possible to make them. For example, in the use of fluorspar and cryolite there is quite a volatilization loss, which varies considerably. This variation being dependent upon batch, heating conditions, etc., is of course not considered in the tables.

[1] Chief Technologist, B. F. Drakenfeld & Co., Inc., New York.
[2] Technologist, B. F. Drakenfeld & Co., Inc., New York

Calculations of the Weight of Glass Produced From the Batch and the Percentage Lost in Melting

In Table I, column 5, are given the percentages of technically pure chemicals which remain in the glass after melting—

Assuming the following batch:

Chemicals	Raw Weight		% Remaining in Glass		Remaining Weight
Sand	1,000	×	100	=	1,000
Soda ash	400	×	58	=	232
Limestone ...	200	×	56	=	112
	1,600		Total Weight		1,344

The total weight melted is determined by multiplying the raw weights by the percentage remaining in the glass (Table I, column 5), pointing off two places for percentage and adding the results. The above batch, the total weight of the raw materials being 1,600 lbs., would make 1,344 lbs. of glass.

To determine the percentage lost, subtract the melted weight of the batch and divide the remainder by the batch weight and multiply by 100, thus: 1,600 — 1,344 = 256 ÷ 1,600 × 100 = 16 per cent loss.

To determine the percentage composition of the finished glass, divide the remaining weight of each constituent by the total weight of the melted glass and multiply by 100. In the above batch which would make 1,344 lbs. of glass, proceed as follows:

$\frac{1,000}{1,344} \times 100 = 74.40\%$ silica in finished glass.

$\frac{232}{1,344} \times 100 = 17.26\%$ sodium oxide in finished glass.

$\frac{112}{1,344} \times 100 = 8.33\%$ lime in finished glass.

Total percentage, 99.99

Table I

FACTORS FOR DETERMINING WEIGHT OF GLASS FROM BATCH AND COEFFICIENT OF EXPANSION

Name of Chemical	Other Names	Chemical Formula	Chemical formula of part remaining in glass	Percentage remaining in glass	Coefficient of expansion, x 10^7
Alumina	Aluminum oxide	Al_2O_3	Al_2O_3	100	0.52
Aluminum hydroxide	Hydrated alumina Precipitated oxide of alumina	$Al(OH)_3$	Al_2O_3	65	0.338
Antimony oxide	Oxide of antimony Irioxide of antimony	Sb_2O_3	Sb_2O_3	100	3.6
Arsenic	Arsenic trioxide Arsenous acid White arsenic Arsenous anhydride	As_2O_3	As_2O_3	Large percentage volatilized	
Barium carbonate	Witherite	$BaCO_3$	BaO	77.7	4.04
Borax	Sodium borate	$Na_2B_4O_7.10H_2O$	$B_2O_3.Na_2O$	53	2.83
Boric acid	Boracic acid Ortho boric acid	H_3BO_3	B_2O_3	56.5	1.12
Boric oxide	Boric anhydride	B_2O_3	B_2O_3	100	1.89
Calcium oxide	Burn lime Quick lime	CaO	CaO	100	4.89
Calcium hydroxide	Hydrated lime Calcium hydrate Slaked lime	$Ca(OH)_2$	CaO	75.6	3.70
Calcium carbonate	Raw lime Whiting Limestone	$CaCO_3$	CaO	56.	2.74
Chrome oxide	Chrome green Chromic oxide	Cr_2O_3	Cr_2O_3	100	5.1
Cobalt oxide	Black oxide of cobalt	CoO	CoO	100	4.4
Copper oxide	Black monoxide Black oxide copper	CuO	CuO	100	2.2
Cryolite	Cryolith Kryolith	$3NaF.AlF_3$	$3NaF.AlF_3$	100	7.4
Feldspar	A natural mineral varying in composition				Calculated from analysis.
Ferric oxide	Iron oxide Crocus martis Venetian red	Fe_2O_3	Fe_2O_3	100 100	4.
Fluorspar	Calcium fluoride Fluorite	CaF_2	CaF_2	100	2.5
Kaolin	Terra alba China clay	$Al_2O_3\ 2SiO_2\ 2H_2O$	$Al_2O_3.2SiO_2$	86	0.275
Lead oxide red	Red lead Minimum	Pb_3O_4	PbO	98	3.12
Lead oxide yellow	Lead monoxide Litharge	PbO	PbO	100	3.18
Lepidolite	Same	By analysis		100	By analysis
Magnesium carbonate	Light magnesium carbonate	$MgCO_3$	MgO	48	0.648
Magnesium oxide	Magnesite	MgO	MgO	100	1.35
Manganese dioxide	Manganese Pyrolusite	MnO_2	MnO	81	2.
Nickel oxide green	Nickel monoxide	NiO	NiO	100	4.
Nitre potassium	Potassium nitrate Saltpeter	KNO_3	K_2O	46.6	5.45
Nitre soda	Chili saltpeter Chili nitre	$NaNO_3$	Na_2O	36.5	4.73
Potassium carbonate	Pearl ash	$K_2CO_3.1\frac{1}{2}H_2O$	K_2O	57	6.68
Potassium oxide		K_2O	K_2O	100	11.70
Rutile	Titanium oxide	TiO_2	TiO_2	100	4.1
Sand	Silica	SiO_2	SiO_2	100	0.15
Salt cake	Sodium sulphate	Na_2SO_4	Na_2O	43.6	5.65
Soda ash	Sodium carbonate	Na_2CO_3	Na_2O	58	7.53
Sodium oxide		Na_2O	Na_2O	100	12.96
Sodium silico fluoride	Salufer Opaline	Na_2SiF_6	Na_2SiF_6	100	unknown
Sodium uranate	Yellow oxide uranium Uranium oxide	Na_2UO_4	Na_2UO_4	100	unknown
Zinc oxide	Zinc white	ZnO	ZnO	100	1.8
Zirconium oxide	Zircon	ZrO_2	ZrO_2	100	.69

Table II

FOR CALCULATING BATCH FROM GIVEN ANALYSES AND MAKING CHEMICAL SUBSTITUTIONS

One Part	Formula	Corresponds to	Formula
Alumina	Al_2O_3	1.53 Aluminum hydrate	$Al(OH)_3$
Aluminum hydrate	$Al(OH)_3$	0.65 Alumina	Al_2O_3
Barium carbonate or witherite	$BaCO_3$	0.77 Barium oxide	BaO
		1.18 Barium sulphate	$BaSO_4$
		0.51 Calcium carbonate	$CaCO_3$
		0.28 Calcium oxide	CaO
		1.16 Lead oxide, red	Pb_3O_4
		1.13 Lead oxide, yellow	PbO
Barium oxide	BaO	1.29 Barium carbonate	$BaCO_3$
		0.65 Calcium carbonate	$CaCO_3$
		0.37 Calcium oxide	CaO
		1.08 Potassium carbonate	$K_2CO_3.1\frac{1}{2}H_2O$
		0.61 Potassium oxide	K_2O
		0.69 Sodium carbonate	Na_2CO_3
		0.404 Sodium oxide	Na_2O
		0.93 Sodium sulphate	Na_2SO_4
Borax	$Na_2B_4O_7.10H_2O$	0.65 Boric acid	H_3BO_3
		0.37 Boric oxide	B_2O_3
		0.28 Sodium carbonate	Na_2CO_3
		0.16 Sodium oxide	Na_2O
Carbonate of lime (limestone)	$CaCO_3$	1.97 Barium carbonate	$BaCO_3$
		1.53 Barium oxide	BaO
		0.56 Calcium oxide	CaO
		2.28 Lead oxide, red	Pb_3O_4
		2.23 Lead oxide, yellow	PbO
		0.84 Magnesium carbonate	$MgCO_3$
		0.40 Magnesium oxide	MgO
		0.81 Zinc oxide	ZnO
Calcium oxide (burnt lime)	CaO	1.79 Calcium carbonate	$CaCO_3$
		3.53 Barium carbonate	$BaCO_3$
		2.73 Barium oxide	BaO
		1.50 Magnesium carbonate	$MgCO_3$
		0.72 Magnesium oxide	MgO
		1.45 Zinc oxide	ZnO
Chrome oxide	Cr_2O_3	1.94 Potassium dichromate	$K_2Cr_2O_7$
		2.25 Sodium chromate	$Na_2CrO_4.10H_2O$
		1.96 Sodium dichromate	$Na_2Cr_2O_7.2H_2O$
Copper oxide, black	CuO	0.90 Red oxide of copper	Cu_2O
Copper oxide, red	Cu_2O	1.11 Black oxide of copper	CuO
Lead oxide, red	Pb_3O_4	0.86 Barium carbonate	$BaCO_3$
		0.24 Calcium oxide	CuO
		0.98 Lead oxide, yellow	PbO
Lead oxide, yellow	PbO	0.88 Barium carbonate	$BaCO_3$
		0.25 Calcium oxide	CaO
		1.024 Lead oxide, red	Pb_3O_4
Magnesium carbonate	$MgCO_3$	2.3 Barium carbonate	$BaCO_3$
		1.82 Barium oxide	BaO
		1.19 Calcium carbonate	$CaCO_3$
		0.67 Calcium oxide	CaO
		0.27 Lead oxide, red	Pb_3O_4
		0.26 Lead oxide, yellow	PbO
		0.48 Magnesium oxide	MgO
		0.97 Zinc oxide	ZnO
Magnesium oxide	MgO	2.48 Calcium carbonate	$CaCO_3$
		1.39 Calcium oxide	CaO
		2.09 Magnesium carbonate	$MgCO_3$
		5.67 Lead oxide, red	Pb_3O_4
		5.54 Lead oxide, yellow	PbO
Potassium carbonate	$K_2CO_3.1\frac{1}{2}H_2O$	1.20 Barium carbonate	$BaCO_3$
		0.93 Barium oxide	BaO
		1.38 Lead oxide, red	Pb_3O_4
		1.35 Lead oxide, yellow	PbO
		1.22 Potassium nitrate	KNO_3
		0.57 Potassium oxide	K_2O
		0.64 Sodium carbonate	Na_2CO_3
		0.35 Sodium chloride	$NaCl$
		0.38 Sodium oxide	Na_2O
		0.86 Sodium sulphate	Na_2SO_4

TO CALCULATE THE COEFFICIENT OF CUBICAL EXPANSION PER DEGREE CENTIGRADE

In making cased glasses, it is frequently desirable to calculate the comparative expansion of the two glasses to be used. In the last column of Table I are given the best known factors for making this determination. To make this calculation, it is necessary to multiply the weight of each constituent by its factor found in Table I, column 6. Add these results and divide by pounds of glass produced by the batch. The resulting quotient is in turn divided by 10,000,000 to obtain the cofficient of cubical expansion per degree centigrade—thus:

Chemicals	Raw weight	Factor	
Sand	1,000	× 0.15 =	150
Soda ash	400	× 7.53 =	3,012
Limestone	210	× 2.74 =	575
			3,737

We have previously determined that the above batch would make 1,344 lbs. of glass—then:

$$3{,}737 \div 1{,}344 = 2.78 \times 100 = 278$$

and—

$278 \div 10{,}000{,}000 = 0.0000278$ = Coefficient of cubical expansion of the above glass. Linear expansion is one-third of the cubical or 0.0000093.

METHOD OF DETERMINING THE BATCH REQUIRED TO PRODUCE A GLASS OF KNOWN COMPOSITION

Assuming that we wish to make a glass of the following analysis:

Sand	(SiO_2)	73 per cent
Soda	(Na_2O)	18 per cent
Lime	(CaO)	9 per cent
		100

It is customary to make the batches on the basis of 1,000 lbs. of sand. Assuming that we are to use 1,000 lbs. of sand, then determine the total weight of the glass to be made, for 1,000 lbs. will be 73 per cent of the total glass.

$$\frac{1000}{73} \times 100 = 1369 \text{ lbs. total weight.}$$

Potassium nitrate ..... KNO_3	0.98	Barium carbonate ..... $BaCO_3$
	0.76	Barium oxide ..... BaO
	1.63	Potassium carbonate .... $K_2CO_3.1\frac{1}{2}H_2O$
	0.47	Potassium oxide ..... K_2O
	0.53	Sodium carbonate ..... Na_2CO_3
	0.31	Sodium oxide ..... Na_2O
Potassium oxide ..... K_2O	2.09	Barium carbonate ..... $BaCO_3$
	1.63	Barium oxide ..... BaO
	4.06	Borax (sodium oxide only) ..... $Na_2B_4O_7.10H_2O$
	1.75	Potassium carbonate .... $K_2CO_3.1\frac{1}{2}H_2O$
	2.15	Potassium nitrate ..... KNO_3
	1.13	Sodium carbonate ..... Na_2CO_3
	1.24	Sodium chloride ..... $NaCl$
	0.66	Sodium oxide ..... Na_2O
	1.51	Sodium sulphate ..... Na_2SO_4
Selenium ..... Se	2.19	Sodium selenite ..... Na_2SeO_3
Sodium carbonate or soda ash. Na_2CO_3	1.86	Barium carbonate ..... $BaCO_3$
	1.45	Barium oxide ..... BaO
	3.61	Borax ..... $Na_2B_4O_7.10H_2O$
	0.94	Calcium carbonate ..... $CaCO_3$
	0.53	Calcium oxide ..... CaO
	2.16	Lead oxide, red ..... Pb_3O_4
	2.11	Lead oxide, yellow ..... PbO
	0.80	Magnesium carbonate .. $MgCO_3$
	0.38	Magnesium oxide ..... MgO
	1.56	Potassium carbonate ... $K_2CO_3.1\frac{1}{2}H_2O$
	1.91	Potassium nitrate ..... KNO_3
	0.89	Potassium oxide ..... K_2O
	1.10	Sodium chloride, salt ... $NaCl$
	1.78	Sodium fluosilicate ..... Na_2SiF_6
	0.80	Sodium nitrate ..... $NaNO_3$
	0.58	Sodium oxide ..... Na_2O
	1.34	Sodium sulphate ..... Na_2SO_4
Sodium fluosilicate ..... Na_2SiF_6	0.56	Sodium carbonate ..... Na_2CO_3
	0.33	Sodium oxide ..... Na_2O
	0.75	Sodium sulphate ..... Na_2SO_4
Sodium nitrate, nitre ..... $NaNO_3$	0.62	Sodium carbonate ..... Na_2CO_3
	0.36	Sodium oxide ..... Na_2O
Sodium oxide ..... Na_2O	3.18	Barium carbonate ..... $BaCO_3$
	4.21	Barium nitrate ..... $Ba(NO_3)_2$
	2.47	Barium oxide ..... B_2O
	6.16	Borax ..... $Na_2B_4O_7.10H_2O$
	2.66	Potassium carbonate ... $K_2CO_3.1\frac{1}{2}H_2O$
	1.52	Potassium oxide ..... K_2O
	1.71	Sodium carbonate ..... Na_2CO_3
	1.88	Sodium chloride ..... $NaCl$
	2.74	Sodium nitrate ..... $NaNO_3$
	2.29	Sodium sulphate ..... Na_2SO_4
Sodium selenite ..... Na_2SeO_3	0.46	Selenium ..... Se
Sodium sulphate ..... Na_2SO_4	1.16	Potassium carbonate .... $K_2CO_3.1\frac{1}{2}H_2O$
	0.66	Potassium oxide ..... K_2O
	0.75	Sodium carbonate ..... Na_2CO_3
	0.44	Sodium oxide ..... Na_2O
Sodium uranate ..... Na_2UO_4	0.80	Uranium oxide ..... U_3O_8
	1.73	Sodium uranyl carbonate. $UO_2CO_3.2Na_2CO_3$
Sodium uranyl carbonate .... $UO_2CO_3.Na_2CO_3$	0.58	Sodium uranate ..... Na_2UO_4
	0.46	Uranium oxide ..... U_3O_8
Zinc oxide ..... ZnO	2.43	Barium carbonate ..... $BaCO_3$
	2.87	Barium sulphate .... $BaSO_4$
	1.88	Barium oxide ..... BaO
	0.69	Calcium oxide ..... CaO
	1.23	Calcium carbonate ..... $CaCO_3$
	2.81	Lead oxide, red ..... Pb_3O_4
	2.74	Lead oxide, yellow ..... PbO
	1.04	Magnesium carbonate .. $MgCO_3$
	0.50	Magnesium oxide ..... MgO

(Continued from page 225)

In calculating the soda ash required, refer to Table II and it will be found that in order to get one pound of sodium oxide remaining in the glass it is necessary to use 1.71 lbs. of soda ash. Now determine 18 per cent of 1,369 or:

$$\frac{1369 \times 18}{100} = 246.42 \times 1.71 =$$

421.37 lbs. soda ash required.

To find the weight of limestone necessary refer to Table II and it is found that 1 lb. of lime in the finished glass requires 1.78 lbs. of limestone in the batch. Then proceed as above:

$$\frac{1369 \times 9}{100} = 123.21 \times 1.78 =$$

219.31 lbs. limestone required.

Then the batch would be:

Sand	1000 lbs.
Soda Ash	421 lbs.
Limestone	219 lbs.

CHEMICAL SUBSTITUTIONS

Table II is also useful in making batch substitutions. The factors shown are calculated from the molecular weight of the various compounds, and by their use the comparative fluxing strength of the different chemicals is obtained.

For example, it is desired to replace 30 lbs. of pearl ash (potassium carbonate) with soda ash (sodium carbonate). Referring to Table II under potassium carbonate it is found that 1 lb. of this material is equivalent to 0.64 lb. of sodium carbonate. Then:

$30 \times 0.64 = 19.2$ lbs. soda ash required to replace 30 lbs. of pearl ash.

Another example, it is desired to replace 200 lbs. of red lead with barium carbonate. Referring to the table under lead oxide red, it will be found that 1 lb. of lead oxide red is equivalent to 0.86 lb. of barium carbonate. Then:

$200 \times 0.86 = 172$ lbs. barium carbonate required to replace 200 lbs. red lead.

In the next issue of THE GLASS INDUSTRY *an important paper by C. E. Gould and W. M. Hampton of Chance Brothers, England, will show how batch and glass containers are affected by solution of refractories and by volatilization of parts of the batch. We are glad to present this important authoritative examination of the subject.*

The Manufacture of Rolled Plate

By ERNST LUTZ*

This work has been revised, so far as the English and the technical expressions are concerned, by F. W. Preston, who has also added a number of notes relating in general to the special conditions of American practice; but it must be understood that the opinions expressed in the text are those of Mr. Lutz, and neither the Editor nor Dr. Preston accepts responsibility for them. This first section of the author's extensive treatise will be followed by another in each consecutive issue until completion of the whole.

THE term "Plate Glass" in Germany includes in a broad sense that "blown" or "best semi-white" glass which, since its manufacture is nowadays practically confined to Bavaria, is frequently known as "Bavarian Plate"; further, since of recent years a certain amount of drawn sheet glass has been ground and polished, the term "plate glass" is no longer sharply delimited even in America. But primarily by "plate glass" is meant "cast plate," and it is with this that we shall deal exclusively in the present work.†

The art of producing blown glass is considerably older than that of producing cast glass. The desirability of producing larger and thicker sheets than is possible by blowing, led to the process of pouring the molten glass on a flat base and of rolling it thereon into a plate. Lucas de Néhou, a Frenchman is considered to be the inventor of this method.

It was Néhou, who, in the year 1688, actually produced commercial wares for the first time by such a process and a plate glass factory was established in St. Gobain for the exploitation of his method. This enterprise was faced at the beginning with many difficulties, and not only those of a technical nature. However, after nearly succumbing, it succeeded in making good progress. Later on, it became the *Manufactures Des Glaces et Produits Chimiques de Saint-Gobain et Cirey*—Plate Glass and Chemical Works of St. Gobain, Chauny and Cirey, which is still one of the leading companies in the plate glass industry.

Fig. 1‡, on another page, gives a good impression of this early period of the new industry. The sheets manufactured at St. Gobain were right from the beginning larger in dimension than those produced up to that time by the blowing process. But while glass keeps its brightness and remains clear and transparent during a blowing operation, it loses its brightness when being rolled, on account of the contact with the base or table on the one side and the roller on the other. The surfaces get rough and the sheet becomes in a sense opaque or "obscured"; in this condition it is called, "rough cast plate glass" or simply "rough plate." In order to obtain bright surfaces and transparency of the glass, the sheet has to be ground and polished on both sides.

The method of Néhou requires therefore two distinct operations; first the production of the rough glass and secondly its grinding and polishing. In consequence a plate glass factory is composed essentially of two sections, viz.:

1. The rough glass shop.
2. The grinding and polishing shop.

Plate glass is mainly used for "store fronts" (or in England, "shop windows"), and in automobiles; it is also employed for show cases, aquariums and sometimes for windows of domestic buildings, railroad coaches, etc., or briefly wherever ordinary window glass is out of the question, on account of limitations regarding sizes and thickness, or where the imperfections of its surfaces and its interior, or its want of flatness make it æsthetically unsatisfactory. In the process of grinding and polishing the cast plate glass acquires perfectly plane and parallel surfaces, so that in contrast to ordinary glass, there is no perceptible distortion of vision of objects viewed through it. Furthermore flatness and polishing give cast plate glass a fine lustre, which distinguishes it advantageously from ordinary glass. The superiority shows up particularly when ground and polished glass is used for mirrors. Such mirrors give an image with practically no distortion.

Cast plate glass finds further applications in wardrobe partitions, table covers, wall dressings, brackets, "push-plates" for doors and in many other industrial and scientific uses. It is also used for large searchlight mirrors. The flat sheet is to this end put over a curved mold and exposed in an oven to a temperature of something over 1,170° F., that is, a temperature at which the glass gets sufficiently soft to adopt itself to the form of the mold. After cooling down, the shaped glass is again polished on either side and silvered on the back surface.

Colored plate glass, particularly black, is applied in inside decorations, name plates, advertisement signs and posters. Rough plate glass is used for glazing work in cases where transparency is not important and where the diffuse light, shining through it, suffices, as in workshops, stables and the like; further for floor coverings, roofing tiles, etc. Rough glass blanks which show no interior flaws, etc., are used for the pressing of lens-discs, which, when ground and polished, provide entirely satisfactory lenses for spectacles and in some cases for scientific instruments.

The glass trade distinguishes between four grades§ or so called "choices" of plate glass, viz.

1st choice = first silvering quality (first silvering).
2nd choice = second silvering quality (silvering).
3rd choice = first glazing quality (mirror glazing).
4th choice = second glazing quality (glazing).

The quality of a glass sheet is judged by the clearness of its interior and the finish of its surfaces. Defects most commonly met with in the interior are: heavy seeds, boil, bubbles, streaks, strings, ream, skim, batch particles, stones and cracks. Defects in surface finish are insufficient grind-

*Of Dessau, Germany. This work will appear in German in the forthcoming new edition of Dralle-Keppeler, "Die Glasfabrikation," due next year, about July. The GLASS INDUSTRY probably will by that time have completed the English translation, with some comments on its applicability to American conditions by F. W. Preston.

†It is our intention to round out Mr. Lutz's treatise by adding a brief survey at least of these allied fileds.—[Ed.]

‡Kindly put at our disposal by the Deutsche Glastechnische Gesellschaft.

§In America there is a fifth quality "O. B.," which forms a large proportion of the total, while "first silvering" is as rare as peacock's eggs—*F.W.P.*

ing, poor and incomplete polishing ("short finish") "bloaches," scratches and "sleeks."

The price per square foot is influenced not only by quality, but by the size and form of the sheet (square, oblong, strip, etc.). Further much depends on the thickness of the sheet. The ordinary run of a factory yields cast plate glass of $\frac{3}{16}$" to $\frac{3}{8}$" thickness: thicker sheets are specially rolled and polished. Cast plate glass below $\frac{3}{16}$" thickness is produced by special methods, which are dealt with later on.

The United States Federal Specifications Board specification No. 123, officially adopted April 1, 1924, for the use of the departments and independent establishments of the government, gives an interesting survey of the wide variety of grades and their definitions of "Plate glass for glazing purposes." It specifies the characteristics and qualities which a certain type of glass must possess and enumerates the many defects that are found in the glass itself and in its working.

Plate glass is defined as transparent, flat, relatively thin glass having plane polished surfaces and showing no distortion of vision when viewing objects through it at any angle.

Plate glass is made at present by casting and rolling large sheets periodically or by rolling a continuous sheet. The sheets are then ground and polished.

For comparison, the definition of "clear window glass" may also be given: "Transparent, relatively thin, flat glass having glossy, fire-finished, apparently plane and smooth surfaces, but having a characteristic waviness of surface which is visible when viewed at an angle or in reflected light.

"Clear window glass is made at present by hand blowing, by machine blowing and drawing into cylinders and flattening, or by drawing directly into a sheet, the surface finish being obtained during the drawing process."

Copies of the specifications adopted by the United States Bureau of Standards are available to interested persons.

In the years just preceding the war, the world consumption of cast plate glass was about 135 millions of square feet per annum, roughly half of which was used by the European countries. On the other hand the consumption of "blown best semi-white" glass was at the time, 35 million square feet and that of ordinary window glass 1,400 to 1,500 million square feet per annum. Of the 135 million square feet of cast plate, Belgium contributed 25, Germany 18.5, England 12, France 12.5 Austria (Czechoslovakia), Holland, Italy, Spain and Russia together 7 million square feet, the rest, about 60 millions, being contributed by North America.

Since the war the world consumption has risen enormously, that of North America alone, about 150 millions, surpassing the whole pre-war world consumption. The domestic production of the United States of America has grown accordingly and this country today has taken the lead in the industry. Glass factory directories for 1930 list the following American plate glass factories: American Plate Glass Corporation, Kane, Pennsylvania, with 7 pot-furnaces; Ford Motor Company, Glassmere plant, Glassmere, Pennsylvania, with 9 pot-furnaces; Edward Ford Plate Glass Company, Rossford, Ohio, with 16 pot-furnaces, recently merged with the Libbey-Owens Glass Company of Toledo, Ohio, as the Libbey-Owens-Ford Company—operating the Bicheroux Process for windshield glass in the plant built by Edward Ford. The National Plate Glass Company, Detroit, Michigan, with works in Ottawa, Ill., and Blairsville, Pennsylvania, also employing the Bicheroux process; Pittsburgh Plate Glass Company Pittsburgh, Pennsylvania, with works in Creighton, Ford City and Charleroi, Pennsylvania, Kokomo, Indiana, and Crystal City, Missouri, with tanks at Creighton and pot-furnaces elsewhere; Standard Plate Glass Company, Pittsburgh, Pennsylvania, with a plant at Butler having 7 pot-furnaces. Furthermore, the Ford Motor Company, in Detroit, Michigan, has erected 4 tank furnaces in the River Rouge works, for the production of plate glass for the Ford car. This company also operates one continuous tank unit at St. Paul, Minnesota.

The Libbey-Owens division of the Libbey-Owens-Ford Company has also installed equipment for converting Colburn drawn glass into thin polished plate, at Toledo, Ohio, while the Clearview Glass Company has built a plant to effect the same transformation in Fourcault glass at Renfrew, Pennsylvania.

In Europe there are at present 9 plate glass factories in Germany, 9 in Belgium, 2 in England, 5 in France, 2 in Czechoslovakia, 1 in Holland, 1 in Italy and 1 in Spain; of the 3 factories existing in Russia, one is said to have re-

ERNST LUTZ

THE author of this work is a prominent mechanical and chemical engineer. He was for many years engaged directly in the manufacture of plate glass in Europe, as superintendent and manager of important plants. At the present time he is manager of the Dessauer Zucker-Raffinerie G.m.b.H. at Dessau, a firm well known in the United States, and associated with the Dessauer Werke fuer Zucker und Chemische Industrie A.G.

Herr Lutz is well known in the United States, through which he has made prolonged journeys, and we are glad to be able to present this treatise of his to our readers. In it will be found a great many valuable suggestions on the operation of pot furnaces, and of rolling equipment. Much of this information concerns fundamental matters, which are applicable, mutatis mutandis, not only to the equipment described, but to the newer forms of apparatus which are continually appearing in this era of change and turmoil.

sumed work. The output of the various factories varies between 2 and 9 millions of square feet per annum. Some North American factories however are laid out for considerably larger outputs. In 1926 the total production of Europe was about 106 millions of square feet, that of the United States about 129 millions, and the latter had increased in 1929 to over 150,000,000 square feet.

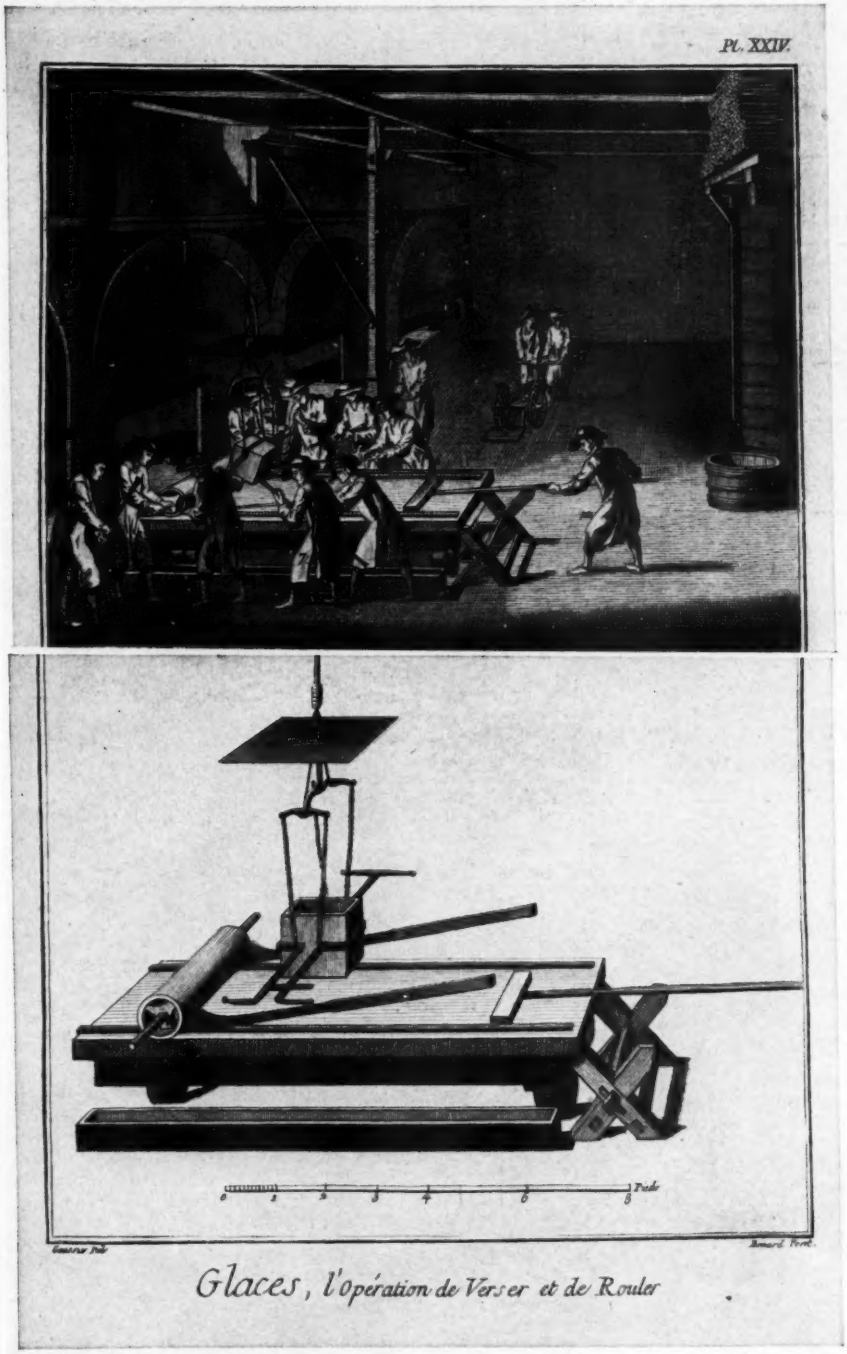


FIG. 1. PLATE GLASS, THE OPERATION OF POURING AND ROLLING

With a few exceptions all European plate glass factories have entered the "Convention Internationale des Glaceries," with headquarters in Brussels. This convention has for its object the regulation of plate glass prices, conditions of sale and production. The clauses of the convention are rigorously adhered to. A certain cooperation also exists with factories not belonging directly to the convention and with the English plate glass works as regards sales prices, supply to the various countries and exchange of statistics. Thus the "Convention Internationale des Glaceries" is primarily an institution for price and production regulation only, which does not touch the financial and technical independence of its members, but by its system of regulating production, exercises a strong influence on the development of the individual works.

In order to balance production and consumption, the convention carries a list of the grinding capacity of each of its members. If for example a factory has 3 grinding machines with grinding tables of 30 feet diameter; then its grinding capacity is noted by the convention as $3 \times 706.7 = 2120.1$ square feet. The total grinding capacity of all members is about 75,000 square feet. About 24,000 thereof are represented by the German, 30,000 by the Belgian and 15,000 square feet by the French factories. Without the consent of the Convention Internationale, no fresh grinding or polishing machine may be installed during each period of the agreement, as otherwise the listed grinding capacities would be affected; there is however, no restriction with regard to alterations on existing machines aiming at improvements of the grinding and polishing methods, so that with the given grinding surface a higher output may be attained.

Production and consumption of plate glass is balanced, i.e., overproduction avoided, by the following procedure: Taking due account of the grinding capacity of a factory and its stock, it is settled in advance each quarter what percentage of its listed grinding surface a factory may use. If for example the restriction for one quarter of a year, which after deduction of the legal days of rest may have 75 working days, is fixed to be 33⅓ per cent and the factory carries 3 listed grinding machines of equal size, then it has the choice

of working on 50 days with all three machines for a full 24 hours, and shutting them down for the rest of the 25 working days, or of working the full 75 days with two machines only, keeping the third as a stand-by, or further, of deciding on any arrangement which keeps within the said restriction.

In another case a listed grinding surface of 1,500 square feet, with a quarter of 75 working days, corresponds to 1,500 times 75 square feet days. With a restriction of 33⅓ per cent, the factory may evidently use 66⅔ per cent, i.e., 75,000 square feet days. The way in which a factory decides to use its allowance is to be brought to the notice of the convention at the beginning of the quarter and without the latter's consent must not be changed during the whole of this time.

The method described of regulating the production naturally stimulated great progress in the art of grinding and polishing. In time the output per square feet of grinding and polishing surface of the existing machines was raised to such a degree that the other auxiliary machine equipment could not keep step and had to be enlarged.

In some countries further central organizations have been created, which direct the sales of all members in the ring; incoming orders are distributed according to certain participation figures. The "Convention Internationale" leaves a free hand to these organizations with regard to sale prices and conditions in those countries.

The rigid linking together under the "Convention Internationale" has now for years ensured a safe basis to the plate glass industries and has held the whole of the European plate glass business on a quiet and steady line. On the other hand the opinion is sometimes expressed that the regulation of the production, together with the price policy of the convention at times is holding consumption back. Whether progress in the plate glass industry is fostered or kept back by the convention is a question on which, at the best, one can only speculate; the following chapters certainly show that there was and is no standstill.

As mentioned before, the regulation of production has certainly had the effect of improving the existing grinding and polishing machinery enormously. Whether free competition would have brought new and better methods is an open question. The regulations of the "Convention Internationale" have an influence on the methods of producing cast plate glass inasmuch as they tend to make the sheets in the first instance as plane and smooth as possible, so that their grinding and polishing takes up the least possible time; the less to be ground, the higher the output capacity of the factory per square foot of grinding surface. The whole equipment for the production of the rough glass itself, as for example the melting furnaces, is in no way restricted by the stipulations and the control of the convention.

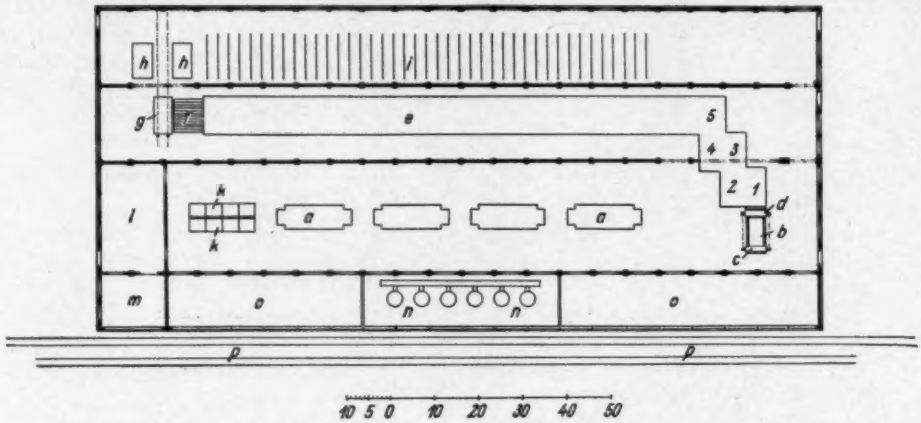


FIG. 2.—LAYOUT OF A ROUGH GLASS SHOP

a=Melting furnaces. b=Casting table. c=Roll. d=Winch for the roll. e=Lehr. f=Trap or sluice at the exit of the lehr. g=Movable table. h=Cutting table. i=Rough cast plate glass store. k=Pot arches. l=Mixing room. m=Discharge of the raw material. n=Gas producer. o=Coal bunkers. p=Rails.

In Germany nine glass factories are established for the production of rough cast plate glass, which altogether possess about 35 pot-furnaces, 20 to 25 of which are working, while the others stand by or are under repair; the nine Belgian factories have about 45, the French factories have about 20 pot-furnaces. The whole of the European works may carry about 120 furnaces, a third of which may be under repair or standing by.

The Manufacture of Rough and Cast Plate Glass

Fig. 2 shows schematically the layout of a rough glass shop of 500 to 530 feet in length, with 4 melting furnaces (a), each of which contains 16 pots and a lehr (e). Of these melting furnaces, there will generally be two or three working, the remaining one or two under repair.

The raw material for the glass batch is brought along on the rails (p), discharged at (m) and mixed in room (l). From the mixing chamber the batch is conveyed either with wheelbarrows or with electric trucks, to the front of the furnaces and fed in by hand or mechanically. The charging of the batch, the melting and the plaining out of the glass take about 20 hours. After the plaining process, the molten glass needs cooling down for 1 to 1½ hours in order to attain the stiffness required for the pouring out ("teeming") and rolling. The teeming and rolling of the contents of the 16 pots of each furnace takes roughly another two hours, so that

evidently within 24 hours each of the furnaces in action is once ready for casting.

The content of each pot corresponds in volume to a large rough glass sheet, so that, if two furnaces are in commission, 32 sheets can be cast per day, or 48 sheets if three furnaces are operating.

Great iron tongs, either hand or machine operated, lift the pots out of the furnaces, and convey them to the casting table (b), where they are emptied immediately in front of the heavy cast iron roll (c) on the cast iron table. With the aid of chains or wire ropes the roll is then rolled over the table by the winch (d) thereby flattening the heap of molten glass into the rough cast sheet. In this process the roll runs on two flat iron guide bars called "trams" or "trangs" lying lengthwise along either edge of the table. The thickness of these plaining rods fixes the thickness of the sheet, while the distance between them delimits the width of the sheet. After having run across the casting table, the roll is drawn on to the winch and at the same time somewhat lifted, so that the rolled sheet, which meanwhile has acquired sufficient stiffness through cooling down, can be shifted from underneath the roll into the lehr. This is done with a sliding shovel called a "stowing" tool. The winch itself is so designed that it forms a bridge which is level with the casting table and the bottom of the lehr. The stowing tool, for pushing the sheet into the lehr, butts against the sheet at its end remote from the lehr, and like the roll, is drawn to it by chains or wire ropes.

In the meantime the emptied pot has been restored to its place in the furnace and another brought along to the casting table. The roll (c) is returned to the opposite end of the casting table and the cycle of the operations starts with the contents of the new pot.

At the present time sheets are produced by this method from 22½ to 30 feet length and 13 to 16 feet width.

Before the fresh sheet can be shifted into the lehr, the preceding sheet must have left the place 1; for this purpose the sheet is pushed by an electrically operated stowing tool to the place 2; before inserting the third sheet, the first one has to be removed to place 3 and so on, until after place 5 it arrives at the lehr "runway," through which, like all the others following, the sheet is gradually passed by mechanical means on to its exit. At the point marked 1 the interior of the lehr registers a temperature of 1,230 to 1,300° F., at the lehr exit about 120 to 180° F. The sheet stays about 3 to 4 hours in the average lehr, i.e., sufficiently long to cool down gradually to room temperature. At the lehr exit the sheets are pulled on to a table (g) on rails, which conveys them to the one or the other of the two cutting tables (h). Here they are carefully inspected for defects, and cut by diamond or glazier's wheel to the best advantage and as large as possible in rectangular sheets. The sheets are then brought either to the grinding room or to the rough glass store (i).

In the rough glass factory are also placed the pot arches (k) for the burning of the fresh pots which in the pot house receive only a preliminary drying. These pot arches are preferably so erected and situated that they can be conveniently operated by the same pot tongs as the melting furnaces.

In plants operated with producer gas, the gas producers (n), which stand near the melting furnaces, not only generate the gas for heating the furnaces, but also supply the fuel for heating the lehr and the pot arches. The coal required by the gas producers is taken off the rails (n) into the bunkers (o) and conveyed therefrom by a travelling crane to the feed hoppers of the gas producers.

The Batch Materials

A fundamental requirement of plate glass in view of its principal applications is an ability to withstand the various influences of the atmosphere; it must therefore be rich in silica and lime and poor in alkalis, which are easily soluble in water. Of these latter the batch should contain only just sufficient to ensure an easy and quick fusion process at the temperature prevailing in the melting furnace. The more silica the batch contains the less is the danger of the surface of the glass becoming attacked by the atmosphere and in time becoming "blind."

The importance of this point lies in the fact, that, as experience has shown, the outer surface of any glass plate, through cooling fastest, is les sensitive to chemical influences than the interior. It is just this more resistant outer skin that is taken off and lost by the grinding process. Even while still in the grinding and polishing shop, alkali-rich sheets on their first polished face acquire a faint discoloration, because they must be laid on a wet cloth for the working of the second surface; the heating of the sheet caused by the polishing favors the formation of these hues. On the other hand any deficiency of alkalis shows up in greater brittleness of the sheet.

In the manufacture of plate glass, sodium salts are used almost exclusively to introduce the necessary easy melting basic oxides, due in the first instance to the fact that they can be obtained more cheaply than potassium salts, but also because sodium affects the resistance of plate glass to atmospheric corrosion less than potash, as potash is more readily dissolved in water. Of the various sodium salts, practically only the calcinated sulphate and the carbonate need be considered; to which of the two preference is to be given is a question of price and profitableness; (see chapter 2, Vol. I, page 163, of Dralle-Keppeler, "Die Glasfabrikation").*

In America soda ash is used almost exclusively; salt cake is sometimes added, so to speak, as an indicator of the state of melting and refining of the batch in the furnace and to counteract the influence of the carbon contained in the combustion gases; additional information on this point is given further on in "Melting and Refining." Even in cases where, so far as costs are concerned, salt cake only should be used, part of the salt cake is replaced by soda ash, as this latter makes the melting and refining of the batch easier.

The sand used for the batch consists in its dry state of about 99 to 99.5 per cent of SiO_2. The proportion in which the basic oxides are added is shown in the table below. Therein is also stated the amount of charcoal or anthracite necessary for the reduction of the sulphate of sodium to sulphite, a preliminary stage of importance since the latter com-

*"Salt Cake or Soda Ash?"

bines more readily with the silicic acid than does the sulphate.

	Lbs.	Lbs.
Sand	1,000	1,000
Limestone	330-400	300-400
Soda ash	.....	250-300
Salt cake	350-400	.....
Charcoal	16-22	.....

In compositions containing soda ash and salt cake, about 3 lbs. of soda ash are replaced by 4 lbs. of salt cake; in proportion as the salt cake is replaced by soda ash the necessary addition of charcoal is lessened as well.

In the early days a small amount of arsenic was used (the effects aimed at are described in Vol. I, Chap. 2, page 182 of Dralle-Keppeler, "Die Glasfabrikation"). Today this practice is almost obsolete; however, if raw materials with a high iron content are used, the presence of arsenic permits the FeO, which gives a green color, to be partially converted into Fe_2O_3 by the action of the As_2O_3. Instead of an intense green color, a less disturbing, light yellow-green tint develops.

The glass produced by the above mentioned composition of raw materials consists of—

SiO_2 .....70 —73.5%
CaO .....12 —15%
Na_2O .....11.5—15%
$FeO + Fe_2O_3 + Al_2O_3$ ..... 0.8— 1.5%

Iron and alumina find their way into the batch with the raw materials, which are never quite pure, iron in particular also from the tools and machines conveying, crushing, mixing and charging the raw materials; alumina on the other hand may also originate from the pot walls. The tint caused by too high a content of iron is more troublesome with the thicker cast plate than with ordinary window glass, particularly if it is used for mirrors. Raw materials for the manufacture of plate glass should therefore contain as little iron as possible, the more so as a higher standard is set for plate glass. The presence of iron of less than 0.15% is of no great consequence, but a slightly higher percentage may prove a handicap in glass for even moderate pretensions. Foreign iron substances must be carefully separated from the batch material either by sieving or extraction with electromagnets.

(Regarding the influence of alumina in the glass, see Vol. I, Chap. 2, page 178, of Dralle-Keppeler, "Die Glasfabrikation.")

The Feeding of the Batch

The feeding of the batch into the pots is even nowadays still done by hand. In many factories for this purpose large charging shovels (a) (Fig. 3) are removably suspended on beams (b). The point of suspension on the handle is so chosen, that when empty, the shovels are almost balanced. The beams (b) are anchored to the structure of the furnace they must be at such a height as not to hinder the operation of the pot-removing tongs. In case the pots are inserted into and extracted from the furnace by a travelling crane attached to the ceiling of the shop, the beams must temporarily be taken away or must be so pivoted that they can be swung aside, as otherwise they come in collision with the hanging parts of the travelling crane.

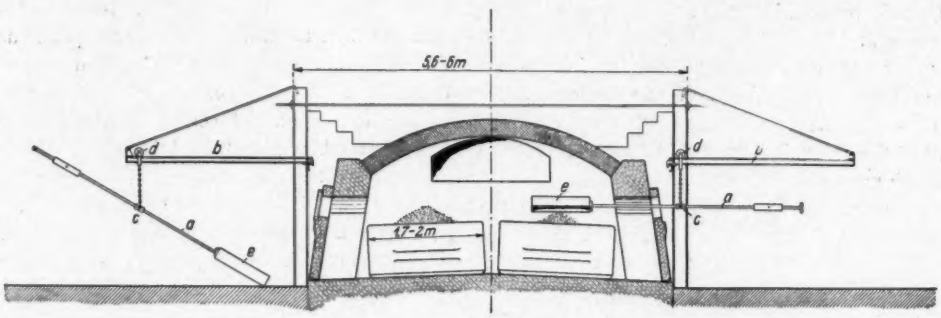


FIG. 3

In line with the general aim to facilitate the work of the charging shovels as much as possible, and to reduce the time of charging of the batch, the trolleys (d) have lately been fitted with ball-bearings. The charging always means some unwanted cooling down of the furnace and thus causes loss of time in melting the batch. Furthermore the stack must be throttled down during the charging as otherwise when tipping the shovel (e) over, the strong draft will carry some of the batch material away and also too much cold air will be drawn in through the open operating holes of the furnace door.

The shovel (e), pressed out of mild steel, is about 30 to 40" long, 12" wide and 6 to 8" deep, i.e., about of such weight that a man can easily operate it with the aid of the lever arrangement mentioned. During charging, the shovels are exposed to the fire, and therefore wear at a quicker rate than the handle, and must frequently be renewed. For this purpose the connection between handle and the shovel proper is easily detachable. During the process of charging, the batch material stands close by the furnace, loaded on large hand trucks, and a second man transfers the material from it into the shovel.

Fig. 4 shows a method of charging, wherein the shovels are suspended from small travelling cranes (h). In this case the shovels are removable about their horizontal and vertical axes. Such an arrangement is sometimes used when the batch material is supplied through hoppers (k) situated at the back of the furnaces. In such a case the batch material is not brought by hand into these hoppers, but is pushed by a

worm-conveyor (l) from the mixing room to the furnace where it drops into the hoppers. For each fill, the shovel has to be conveyed to the back of the furnace. If the whole apparatus is not of light construction and the travelling crane not equipped with large runnerwheels on ball bearings, the moving about of the shovel has to be done electrically. Such a plant will not show any saving of time as compared with that shown in Fig. 3. It avoids only the manual labor for shifting the batch material in the shovel pockets (e) and the ensure that at each filling stroke the shovel is placed exactly over the melting pot, the whole upper part of the filling mechanism can turn on its vertical axis. All movements of this machine are electrically operated.

With this pot-filling machine the charging times of some factories have been reduced to a minimum and manual labor also has been saved to an appreciable extent, but in spite of this, its introduction proceeds very slowly. A pot filling machine is naturally complicated, cumbersome and expen-

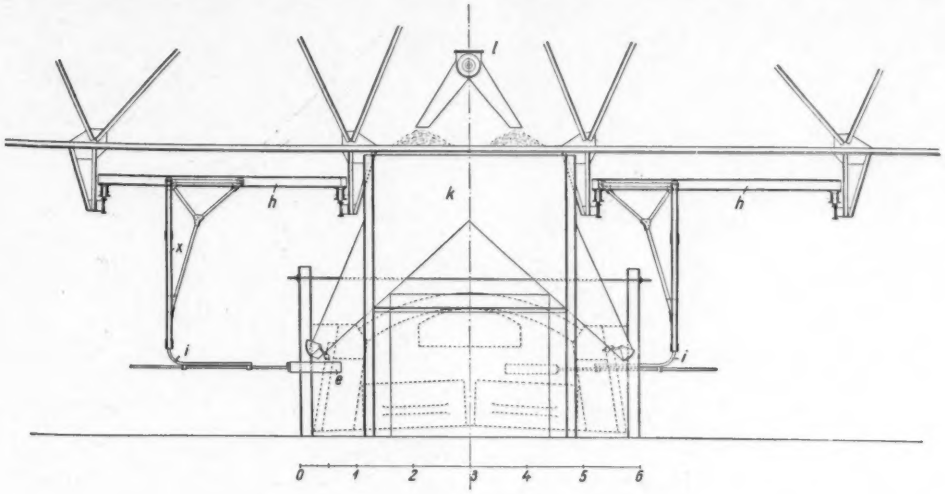


FIG. 4

conveying of the shovels from the mixing room to the furnaces.

On the other hand the moving of the batch with the aid of the worm (l) and its sinking down in the hoppers (k) certainly risks the formation of an uneven mixture, which is particularly undesirable with plate glass, for which a high standard is set. As is known, an ordinary plain worm simply pushes the material ahead, letting the heavier parts gradually sink down, whilst the lighter ones are forced upwards. It is therefore necessary for the surfaces of the worm to carry projections of such a form, that at the same time as the batch material is moving forward, it is also turned over. Shaking channels, scrapers and vibrating transporter-belts are not advisable for this purpose.

Arrangements as shown in Fig. 4 have been definitely adopted only in exceptional cases in plate glass factories. Any de-mixing of the batch causes a poor and irregular melting process; the incomplete reduction in many points of the melting material leaves unmolten batch particles in the glass mass and on the top of it a great part of the carbonic acid is formed too late to be released, so that it remains in the glass in the form of innumerable small bubbles.

Fig. 5 shows a pot-filling machine, which travels on the shop-floor. From the furnaces it is maneuvered to the mixing room, where the batch material falls out of the bunkers directly into the pockets (o) of the filling truck; the charging shovel can be pushed to and fro in a guide (p). In the outer position of rest the shovel just clears the lower part of the pocket (o) and fills itself automatically. When the charging shovel is pushed into the furnace, this lower opening of the pocket is automatically shut by a gate valve. In order to

sive; the sliding contacts for supplying current to the motors are an unpleasant necessity. If proper care is not taken, the insertion of the charging shovel through the hole in the furnace door may damage the latter. Designs are, however, available, where the shovel is automatically guided to the

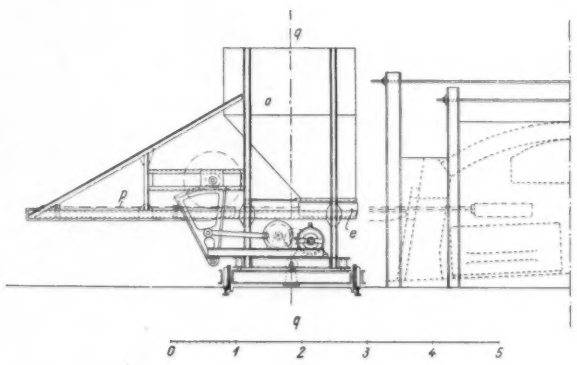


FIG. 5

pot and where this possibility of damaging the furnace door is altogether avoided. For example, a number of such machines to the designs of J. W. Cruikshank are working entirely satisfactorily in North American glass works.

Fig. 6 shows another method of filling the pots which was once tried out. In this case the pots are charged outside the furnace. It would of course be most convenient to fill the pots when they return empty from the casting table, but as a rule there are still in the furnace other pots, whose content is not yet poured out. The introduction of a freshly

filled pot would most likely cause its batch material to be partially blown about, thereby contaminating the molten contents of the other pots—the furnace temperature itself would furthermore be appreciably affected and lowered by the cold batch, instead of being heated up in the ordinary course with the empty pots for ¾ to 1 hour to higher temperatures. It would be necessary therefore first to push the pots into the furnace when they come back from the casting

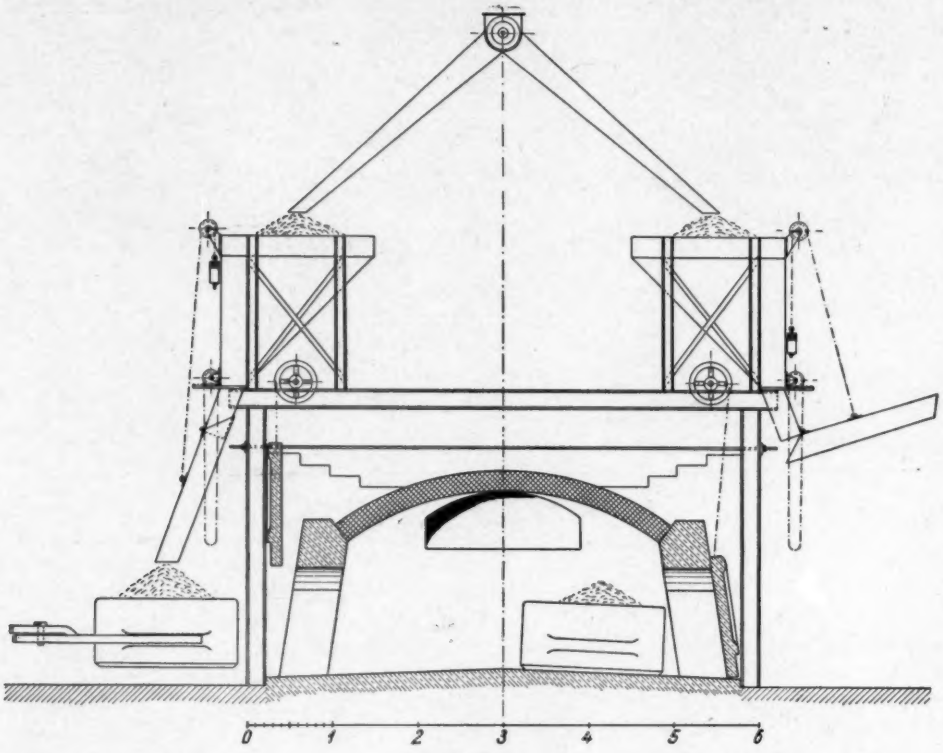


FIG. 6

table and then to take them out again, in succession, for refilling.

This procedure like the other, would involve a severe chilling of the furnace. When it came to the second and third refill, the pots, which gradually reach white heat, would not stand such treatment. Their place on the furnace bottom would every time have to be rearranged, causing a good deal of lost time. Thus for various reasons the fusion process with such an arrangement would take longer than in the case of charging with shovels; the more so as the heap of batch material would be filled in all at once, while with shovels it gets more easily and uniformly heated up.

There is still a further source of trouble. Charging the whole load in one big heap may cause the residual molten glass in the pot to be pressed up, and to overflow and cover part of the batch material; the mix so covered will not fuse evenly, leaving batch particles and bubbles in the glass.

Machinery like Fig. 6, accordingly, cannot be recommended for plate glass.

Melting and Refining

In view of the exacting specifications for plate glass and also the peculiarities of its production, the process of melting and refining is most important. The continuity of the furnace work is very violently interrupted every time one of the large pots is withdrawn for the casting of the rough plate glass. With the methods employed in other branches of the glass industry where smaller amounts of molten glass are successively withdrawn from the pot or the tank, or where the glass is drawn in strips or cylinders, the furnace maintains an almost constant temperature and loses but little heat. The more or less simultaneous withdrawal of the sixteen to twenty pots in a plate glass furnace, on the other hand, causes an appreciable temperature drop in all parts of the furnace. The further requirement that the temperature and the degree of viscosity throughout the pot content must be as uniform as possible, involves much more exacting work than in the case of other glass products.

(*To be continued*)

Dimensional Changes in Glass Resulting from Heating Cycles

In obtaining expansivity curves for a medium flint glass, samples of the glass were tested which had previously received one or another of several different heat treatments. In these tests heating cycles were employed which made it possible to determine the magnitude of the so-called permanent changes in length which are caused either by the annealing or the disannealing which may result from the heat treatment imposed on the glass by the heating cycles employed. Annealing decreases the length and specific volume, while disannealing increases them. These effects are related to certain ice-point shifts observed in thermometers, and to other effects sometimes observed in various types of glassware.

(See Bureau of Standards Journal of Research, September, 1930.)

Data on Grinding and Polishing

By F. W. PRESTON

FROM time to time grinding and polishing machinery is built in which the fundamental data are not taken into account. In consequence it sometimes happens that there is an excess or deficiency of the grinding units with respect to the polishing units, or that the motors are under or overloaded; or the grinding does not produce a flat surface, or the polishing is very uneven, or the heating of the glass from polishing is so uneven as to cause breakage.

A few of the data are set forth below, and criticism of the values cited is invited.

Grinding

If we have a given number of square feet to grind, and a given depth of glass to grind away, the volume of glass to be ground to powder can be calculated. Let this volume be V cubic inches.

If the grinding is effected as usual with sand as the abrasive and cast iron as the material of the runners, and if these runners press on the glass with a total force P lb, and move with an average velocity v (*inches* per minute), then

$$V_1 = Pv/1{,}500{,}000 \qquad (1)$$

Here V_1 is the volume removed per minute, and V/V_1 gives the time in minutes to do the rough grinding.

The total time to grind and smooth thoroughly is generally about $2\frac{1}{2}V/V_1$. (2)

In the case of continuous grinding machines, we can calculate from equation (1) the amount of glass removed by a single machine, working on coarse sand, per minute. We know that to finish so many square feet per minute needs a certain volume of glass to be removed. Dividing the last figure by the first will give the number of machines needed to do the rough grinding. Multiply by $2\frac{1}{2}$ to get the number of machines that will be needed not only to grind the glass but to put a thorough "smooth" on it.

Take the total volume of glass to be removed, in cubic inches per minute, and divide by 2. This will give approximately the number of pounds of grinding sand that must be supplied per minute. The figure really varies with the sand to some extent, but the above is not far from the truth with many sands, and suffices for estimating the capacity of grading equipment, etc.

The power used by the grinding machines, at the table face, varies greatly with the grade and sharpness of the sand. It may be calculated from the coefficient of friction between runner and glass. For rough sand this coefficient has a value of .18; for the first fine sand it may be about .07, and for the emery .035. Add the power needed to drive the machine out of contact with the glass and the power of the motors may be ascertained.

Polishing

In polishing, the coefficient of friction does not vary so much. It tends to have a value around unity. In a long row of continuous machines, the maximum power will occur about two-thirds or three-quarters of the way down the line. The minimum will be at the beginning, where the glass is cold; this is likely to be some 30% below the average. The maximum will be some 20% above the average, and the end of the line will be very near the average for the whole. Similar phenomena are observed during a "run" with the discontinuous system using circular tables. For engineering purposes it is usually sufficient to take the average coefficient as .9 or 1.0. Given now the weight and speed of the polishing blocks the average power consumption of a machine can be calculated.

In the older type of circular machines, it required about .6 H.P. hrs. to polish completely one square foot of glass on one side. Hence from this fact and the data of the last paragraph, the duration of the "run" could be calculated. One might use a small power for a long time or a high power for a short time, and the product of the two would come out about the same in all cases.

In the spectacle industry an equally good finish is obtained with .3 H.P. hrs. per square foot. With the continuous plate glass polishing machines now coming into general use, the energy consumed seems to be lower than with the old circular machines, and among the smaller continuous units it may approximate to spectacle glass figures. This is possibly because lower speeds of block movement rule in these small units, and the felt grips the glass more steadily, and works more efficiently.

Given the necessary energy consumption per square foot of glass, the number of square feet to be produced per minute, and the power developed by a single machine, we obtain at once the number of machines that must be used in a continuous installation.

The smaller continuous units produce a somewhat more uniform distribution of polish than the larger ones, if blocks of the standard size, and in a single annulus, are used in each case. In other words, the fewer the blocks in an annulus the more even the polish across the width of the glass.

If the glass travels very slowly under the polishing machine, it heats up locally, and breakage is apt to ensue. A moderate width of glass and a rapid travel is therefore better than a great width and a slow travel. The minimum permissible speed presumably varies with the width of the decks; up to date there seems to be a tendency in most plants to adopt a travel per minute equal to or slightly greater than the width of the deck.

Find Big Crystal of Beryl

The American Museum of Natural History, New York, has been presented by J. P. Morgan with a four-ton beryl crystal, the largest ever found in the United States, measuring seven by four feet and weighing four tons. From beryl ore is derived the beryllium used in making beryllium glass. The semi-precious stone came from the Bumpus quarry at Albany, Maine. According to Dr. George F. Kunz, gem expert of Tiffany & Co., beryl mining is carried on in Colombia, Russia, South America and the United States.

Glass Industry

ESTABLISED 1920

The First Trade Journal Devoted Primarily to Glass Technology, Engineering, Raw Materials and Glass Factory Equipment and Operation

Published Monthly

Copyright, 1930 by

GLASS INDUSTRY PUBLISHING COMPANY, INC.

24 West 40th Street, New York

Telephones { Chickering 2354 / Chickering 2355 — Cable Address Glasdustry

G. W. Cooper, Managing Editor

Subscription Price.....$2.00 a Year
Single Copy .....20 Cents

THE GLASS INDUSTRY circulates extensively among American and foreign glass manufacturers, their business executives and technical and factory operating staffs.

Vol. 11 OCTOBER, 1930 No. 10

CONTENTS

	Page
Glass Calculations Simplified	223
The Manufacture of Rolled Plate	227
Data on Grinding and Polishing	235
Editorial:	
The Unemployment Problem	236
The Laboratory:	
Bisulphate Fusion	237
Correspondence:	
Schott-Jena Dense Barium Crown	237
Society of Glass Technology, London Section	237
French Patent Office Report for 1929	237
On the Sun-Swept Shore of Chesapeake Bay—Summer Meeting, Glass Division	238
Recent Patents	239
Ashdown Rotoscope "Gears Up" Observer's Vision	241
Heat Resistant Alloy Applicable to Glass Plants	241
Book and Bulletin Reviews	241
Glass Factory Equipment and Supplies:	
New Device for Installing Windshield Glass	242
New Four-Wheel Drive Shovel Truck	242
Getting Ready for the Coming Blizzards	242
Glass Container Association Semi-Annual Meeting	243
The Glass World and What It Is Doing:	
Glass a Large Item in Furniture Costs	244
Mirror Industry Again on the Upgrade	244
Changes in Important Marking Regulations	244
Tariff Commission Orders Investigations of Glass Costs	245
Corning Glass Plants in Operation	246
International Glass Cartel Being Organized	246
Trade Activities	246
Recent Death	247
Coming Meetings	247
What the World Wants	247
Inquiries Received	247
Readers' Wants and Offers	247
Current Prices of Glass-Making Materials	248
Monthly Summary of U. S. Foreign Commerce in Glass	248

CLASSIFIED BUYERS' GUIDE, PAGE 20
INDEX TO ADVERTISEMENTS, PAGE 22

The Unemployment Problem

THE problem of unemployment is not a simple one. It's solution requires as thorough a study of causes as any of the more familiar problems of business and management. The statistics that are now available are not of much help.

Nevertheless, some communities have found that seasonal unemployment can be reduced to an almost negligible amount, and this encourages us to believe that if variations over months can be eliminated we can have some hope of controlling the variations over years. Probably the most logical development of this nature is the movement to hold back construction or set up reserves during prosperous times to enable pushing forward public construction and maintainance during slack periods. It is only in times of depression that the matter of unemployment insurance is brought forth.

But in thinking of unemployment insurance we should remember that the responsibility for unemployment is not on the shoulders of the workers, it is in the hands of the leaders of commerce and industry. Moreover it is the reduction in the purchasing power of the consumer that causes business depressions and not the depression which causes unemployment. When the business man learns that it is to his interest to maintain this purchasing power, then we will find that stabilization of employment will merit as much consideration as any of the more familiar duties of management.

The best unemployment insurance obviously is the provision of employment for all at all times. If it is possible to measure the risk, to foresee and calculate the probabilities so that adequate reserves can be set up during prosperous times to insure incomes to workers during periods of depression, then it is likewise possible to use the same statistics and reserves to provide steady work.

But if unemployment protection takes the form of an insurance providing a form of dole or subsistence payment in lieu of wages but for which no work is returned, it would be deplorable indeed. Nothing is so stifling to initiative, to thrift, to the desire for home ownership as the knowledge that one does not need to work to get a living.

Whether or not we are able to cope successfully with the prevention of unemployment during this generation, it is evident that we intend to provide something for those who are too old to work. Old age pension plans have been adopted in at least eleven states during the last few years and are being considered in several more states.

These pensions, for the most part, are now charges against the public treasury. While there is some objection to this we probably can find no better system. Certainly any plan would be prenicious which provides that the cost of old age insurance would be charged to employer or employee according to the probability of the employee becoming eligible to a pension. Moreover, if old age pensions were to be provided by the employer for any workmen reaching a certain age limit we would expect a decided effect on the amount of employment that would be offered to workmen whose age was within a few years of the limit.

These problems are decidedly complex but an economically sound solution to them will be reached by our industrial and

commercial leaders. But the answer will be in prevention of the disease rather then in alleviation of the pain. Let us have unemployment insurance by all means but let it provide jobs for the jobless and not put a premium on idleness.—*D. E. S.*

The Laboratory

Bisulphate Fusion

By S. R. SCHOLES

"Fuse the residue with potassium bisulphate." This is a direction which many of us dislike to follow, because of the fuming and spattering of the reaction, the attack on our platinum crucibles, and the difficulty in dissolving the product.

The bisulphate fusion amounts to heating with sulphuric acid, to which an alkali sulphate has been added. The value of the alkali sulphate lies in the fact that it raises the boiling point of the acid, enabling us to heat it to a higher temperature before destructive boiling occurs.

It follows that this reagent is of value on basic oxides, capable of forming sulphates. We may not always expect clear fusions, because the sulphates formed may not be soluble in the melt. Since silica is not a basic oxide, it is insoluble in fused bisulphate. So are the glasses, and most silicates, although some clays may be opened for alumina determination and separation of silica by this method.

A convenient receptacle for the fusion is pyrex glass, in the form of a small Erlenmeyer flask. This is proposed by Scott, Standard Methods of Analysis, and has been found most convenient. There is no attack on the glass. Temperatures high enough to soften the glass are unnecessary. At any rate, the attempt to use high temperatures in bisulphate fusions is a mistake, because the effective sulphuric acid is simply boiled away, leaving the inactive normal sulphate.

By using glass, not only is the corrosion of platinum avoided, but the reaction mixture can be treated with water and hydrochloric acid or other solvent in the original flask without transfer. Moreover, the shape is more convenient, and the upper portion of the flask-wall acts as a condenser for the acid, reducing fumes.

A further advantage of the glass flask as a fusion receptacle lies in the fact that the progress of the reaction may be watched. Needless to say, quartz apparatus is ideal for this work.

The reagent need not be potassium bisulphate, since we often find the double sulphates of potassium and refractory bases less soluble than the corresponding sodium salts. A convenient plan is to add sulphuric acid and anhydrous sodium sulphate separately, providing usually for an excess of acid. If the sodium sulphate is not completely free from water, a preliminary heating before adding the sample to be analyzed will get the foaming over with before the fusion proper is begun.

A GROUP OF REPRESENTATIVE MANUFACTURERS and users of laboratory glassware have cooperated with the Bureau of Standards to establish a Commercial Standard for Interchangeable Ground Glass Joints.

Correspondence

Schott-Jena Dense Barium Crown

To the EDITOR:

We noticed in the September issue of your GLASS INDUSTRY a very interesting article by Mr. H. W. Lee about the Development of the Photographic Lens.

Mr. Lee referred, at various times, to the optical raw glass made by Schott & Gen. of Jena and on page 203, he has the following to say:

> "Another direction in which the range of glasses could with advantage be extended, is in the production of denser barium crowns. At present about 1.623 is the highest refractive index reached, which represents but a slight advance on Schott's list of 46 years ago. An increase to at least 1.65, with the small dispersion characteristic of the present barium crown, is desirable from the point of view of the lens designer."

We are agents, in this country, for Schott & Gen. of Jena and are pleased to inform you that the Schott-Jena factory is actually making such glass having a refractive index of 1.6578 and a dispersion of V 51.2.

45 West 45th Street
New York,
September 6, 1930

FISH-SCHURMAN CORPORATION.
(Signed) FERDINAND SCHURMAN, *Pres.*

Society of Glass Technology

London Section

A meeting of the London Section of the Society of Glass Technology which was held on Wednesday, May 7, 1930, at Messrs. Holophane, Ltd., Elverton Street, Westminster, is reported through the courtesy of the honorary secretary, Mr. V. Stott.

Mr. Geoffrey Marchand was in the chair and Mr. Edward Meigh opened a discussion on "The Measurement of Temperature in Furnaces." He was not satisfied with the methods in general use for the measurement of temperature in furnaces and found the performance of temperature measuring instruments left much to be desired. He provocatively stated, though with disarming geniality, that pyrometers were to an experienced furnace-man as fleas to a dog, they provided him with a harmless occupation for his spare time. The representatives of instrument manufacturers who were present by invitation were not slow to take up the opener's challenge and a spirited and informative discussion took place. Considerable discussion also arose on the question of to what extent observation of furnace temperatures provides an adequate control of the temperature of the glass itself.

After lunch the party proceeded to the glass works, where they divided into four groups and under the direction of Messrs. Cauwood and Langwell, Bowmaker, Hemingway and Robertson were conducted round the works. The arrangements for the visit had been very carefully prepared and members saw without confusion or loss of time the wharf, oil installation, batch plant, furnaces, lehrs, warehouses, grindery, compressor house and fitting shop. After the visit to the works the members as guests of The Canning Town Glass Works, Ltd., were taken on a motor trip across the Isle of Sheppey to tea at Warden Bay.

The London Section made an enjoyable visit to the Queensborough works of The Canning Town Glass Works, Ltd., in June, thirty-one members traveled by motor coach from London and after lunch at the Royal Fountain Hotel were joined by about twenty other members who were traveling independently.

French Patent Office Report for 1929

The total number of applications for patents and of improvements to existing patents reached 23,327 in 1929, as compared with 23,114 in 1928 and 23,067 in 1927, according to the statistics published by the French Patent Office in the *Journal Officiel*, August 20, 1930. The number of patents granted to citizens of the United States reached 2,154 in 1929, as compared with 1,643 in 1928 and 1,435 in 1927; those granted to German citizens aggregated 4,143 and to British subjects, 1,848, in 1929.—*Consul General L. J. Keena, Paris.*

On the Sun-Swept Shore of Chesapeake Bay

GLASS DIVISION SUMMER MEETING, OCTOBER 4-6

A POLL of the membership of the Glass Division of the American Ceramic Society taken by the chairman, J. T. Littleton, Jr., of the Corning Glass Works some weeks ago showed that a large proportion of the members were in favor of repeating last year's good time at Cove Point, Md., where the summer home of F. C. Flint of the Hazel-Atlas organization is located and where a most enjoyable week-end was spent early last October, rather than make a more experimental trip to a camp in Ontario. It was, therefore, settled that those of the boys arriving by train should plan to be in Washington on Saturday morning, October 4, by 9 A.M. Dr. Finn or a representative will meet them and attend to the arrangements and transportation to and from Cove Point, which is about 65 miles below the Capital City. Those members who do not intend to motor direct to Cove Point should notify Dr. Finn at the Bureau of Standards by October 2 as to what road and train they will arrive on.

DISTINGUISHED GUEST EXPECTED

It is probable that the meeting will be attended by a most distinguished guest, Dr. Schott, of Schott & Gen, the famous glass works of Jena, Germany. There were hopes of having also Dr. G. Gehlhoff, of the great Osram Laboratory at Berlin, but it now seems unlikely he can attend.

The advice is given to take along a blanket, if convenient, and old clothes. Fishing, swimming, oysters and crabs are among the attractions, and motor boating and sailing are scheduled. For accommodations, according to Littleton, the members will "bum on Flint", Peters and Merritt to full capacity and the excess use tents.

In view of the fact that house accommodations are quite limited and that a big overflow of members will have to be provided for in tents, visitors are advised to take the precaution of carrying along warm blankets for frosty nights. A cooperative commissary with a competent kitchen staff will be provided. One feature of the program will be a shore dinner.

If those going to Cove Point by automobile can carry additional passengers from Washington to the Point, they are requested to advise Dr. A. N. Finn, chairman of the transportation committee, at the Bureau of Standards, Washington, D. C., as to how many additional passengers they can take. Dr. Finn has sent a letter to members advising that all such information should reach him not later than October 2. His Washington telephone number is National 5566. All those arriving by train should advise Dr. Finn in advance of the hour and place of their arrival, so that he can arrange for their transportation to Cove Point by special buses, which make the 65-mile trip in about 1¾ hours.

Everybody smiling—Why not?—unspoiled surroundings, congenial comrades, interesting talks.

Retrospective of 1929

GLASS DIVISION
at Cove Point Beach

MEMBERS:
Don't miss the "Frolic of 1930"
at Cove Point, October 4—
Bigger and Better than ever!

Management: Littleton and Flint.

SPOOKS! ! !
Look to the right and see the awful consequences of last year's scandalous double exposure! . . .

COVE POINT LIGHTHOUSE,
October, 1929.

. . . haunted by the *Spirits* of a *quar*tette of well-known glass men.

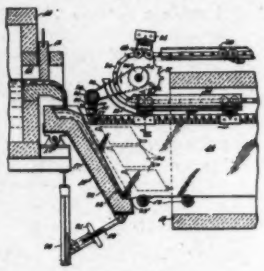
"Dost thou recognize yon eery spectres!"

Recent Patents

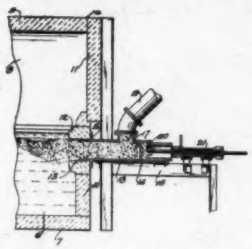
NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C., Price 10c each

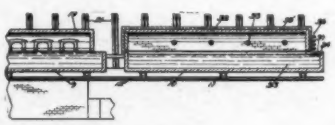
METHOD OF AND APPARATUS FOR DRAWING SHEET GLASS. U. S. 1,760,499. May 27, 1930. Victor E. Hofmann, Toledo, O. Filed 1/25/29. An object is to provide an improved method of and apparatus for drawing sheet glass in which only a relatively small area of the sheet comes in contact with any part of the forming or drawing apparatus and in which the sheet is not rolled or bent in any manner whatsoever. To this end there is provided means to draw the sheet on edge from a drawing trough and carry the sheet in a straight line from said trough through the annealing leer to the point at which said sheet is severed into sections of predetermined size. Another object is to provide means whereby a single annealing leer may be utilized to anneal a plurality of continuous sheets of glass simultaneously.



BATCH-FEEDING MECHANISM. U. S. 1,761,229. June 3, 1930. Ingvald O. Pedersen, Pittsburgh, Pa., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 10/25/26. In combination, a glass melting furnace including a tank, a charge block arranged in one wall of the tank and having an opening therein, and means for forcing a charge of glass batch ingredients through said opening without exposing the interior of the tank to the atmosphere, the inner end of the charge block extending within the tank and beyond the wall with which it is associated.

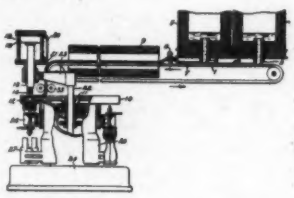


PROCESS AND APPARATUS FOR PRODUCING SHEET GLASS. U. S. 1,761,200. June 3, 1930. John L. Drake, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 10/29/27. There are provided preferably a plurality of receptacles or tanks movable alternately to a melting position and a sheet forming position, a mass of molten glass being melted and refined in one receptacle while completely refined and settled molten glass is being removed from a second receptacle. This is accomplished preferably by utilizing a single cap provided with stationary heating means, one of the receptacles being movable under the cap so that the heating means will effect the melting of a mass or body of molten glass therein. The receptacle is then permitted to remain in this position until the glass is completely refined and settled after which the same is removed therefrom to a position where the glass may be removed in sheet form. During the removal of the completely refined and settled glass from the first tank, a second tank is moved under the cap so that molten glass may be melted and refined therein.

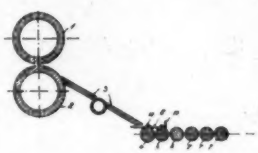


APPARATUS FOR FORMING SHEET GLASS. U. S. 1,761,195. June 3, 1930. John L. Drake, Toledo, O., assignor to Libbey-Owens Glass Co., Toledo, O. Filed 2/19/26. A sheet glass drawing apparatus with means whereby a sheet of glass may be drawn a relatively short distance vertically through a positively controlled artificially created heat absorbing atmosphere, and then bent into a horizontal plane while still plastic. This artificial heat absorbing atmosphere is preferably created above the prescribed molten glass area by cooled enclosures out of contact with the glass, and formed with a pair of cooled vertical members positioned immediately in front of the lip tiles and a pair of cooled horizontal members, having L-shaped ends.

METHOD AND APPARATUS FOR MAKING BLOWN-GLASS ARTICLES. U. S. 1,770,335. July 8, 1930. Kitsuzo Fuwa, Tokyo, Japan, assignor to General Electric Company. Filed 6/8/29. Automatic apparatus for making so-called veneer glass articles which comprise two or more layers of clear or colored glass. Heretofore such articles have been produced mostly by hand work. The article is produced from a blank obtained by punching from a ribbon of plastic glass consisting of two or more layers of different glasses. The punched-out blank is then delivered to a blowing device and blown into the desired article in the ordinary manner. The ribbon of plastic glass from which the blank is punched is formed by delivery from receptacles each containing a different glass from each of which a stream of molten glass is caused to flow, preferably upon an endless belt conveyor, which carries the ribbon composed of the layers of glass to the punching apparatus. Preferably the composite ribbon is passed through a re-heating furnace before delivery to the punching machine.



METHOD AND APPARATUS FOR CONVEYING STRIPS, SHEETS, OR PLATES OF GLASS. U. S. 1,767,907. June 24, 1930. Seraphin Werotte, Auvelais, Belgium, assignor to The American Bicheroux Company. File 1/16/28. Consists mainly in substituting a positive or automatic start for the natural start of the conveying operation, at the exit from glass-making apparatus, by receiving the leading end of the sheet on a rigid member, supported by the first few or at least the first two conveyor rollers, so that correct engagement on the latter will always be insured whatever may be the consistency of the leading edge of the strip, sheet or plate at the exit from the glass-making apparatus. The invention also consists in preferably using a metallic "bait" for the member receiving the leading end of the strip, sheet or plate, the said "bait" being designed so as to obtain a strong adherence of the end of the strip, sheet or plate in order to prevent any possible separation. The cut shows "bait" in the waiting position to receive the strip, sheet or plate.



GLASS SURFACING APPARATUS. U. S. 1,767,123. June 24, 1930. John L. Drake, Toledo, O., assignor to Libbey-Owens Glass Company. Filed 5/4/26. A vertical shaft centrally mounted in the top of the frame work and eccentrically arranged with relation to said spindle, a plurality of universal connections between said shaft and spindle, a worm gear carried by said bushing, a worm meshing with said worm gear, means for driving the shaft to impart rotary movement to the spindle, and operative connections between said driving means and said worm for rotating the bushing to cause a shifting circular movement of the surfacing tool upon the sheet.

GLASS ROLLING MACHINE. U. S. 1,767,131. June 24, 1930. Harris B. Holt, Pittsburgh, Pa., assignor to Rosedale Foundry & Machine Company. Filed 7/19/27. The combination of a table and a truck movable relatively to the table, the truck including a body portion which throughout the range of truck movement is disposed beyond one end of the table, and including also parallel arms which in the range of truck movement advance and recede along the sides of the table, glass spreading means mounted upon the arms of the truck.

MEANS FOR CUTTING SHEET GLASS. U. S. 1,765,552. June 24, 1930. Lambert Von Reis, Herzogenrath, Germany, assignor by mesne assignments to The American Bicheroux Company. Filed 7/20/26 and in Germany 7/27/25. Relates to a method and a device for cutting sheet glass as made by the Bicheroux process while still in plastic condition.

METHOD OF FORMING GLASSWARE. U. S. 1,766,555. June 24, 1930. Maurice A. Smith, Jeannette, Pa., assignor to McKee Glass Company, Jeannette, Pa. Filed 7/11/28. Relates particularly to the forming of hollow ware in the nature of a glass vessel having an opening therethrough, and comprises method of forming glassware in expanding a mass of glass by a blowing action, and cutting out a mid portion at one side of the mass and causing the edges left by the cut-out portion to unite with the remainder of the mass.

DRAWING SHEET GLASS. U. S. 1,761,234. June 3, 1930. Clifford A. Rowley, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 7/24/22. If the formation of waves or wrinkles is to be forestalled or prevented, it is essential that the side stretching or lateral tension shall be applied at the very source of the sheet and continued through this critical forming period. The edge-forming rollers have been retained but have been elevated somewhat above the molten glass, about to the upper limit of this initial forming zone. The side-stretching means are placed below the edge-forming rollers, and between these rollers and the pool of molten glass.

DRAWING SHEET GLASS. U. S. 1,761,235. June 3, 1930. Clifford A. Rowley, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 1/25/24. Improved process and apparatus for simultaneously and independently drawing a plurality of sheets of glass. Three changes from the form of drawing mechanism previously used have been made; first, shorter links are used for the flexible moving flattening table; second, a simpler and more compact drawing mechanism for holding the sheet in frictional contact with the flattening table; third, the separate drawing mechanisms are arranged in staggered vertical relation, whereby the space between the superposed sheets need be no greater than necessary for either one of the two mechanisms.

SHEET-GLASS APPARATUS. U. S. 1,759,235. May 20, 1930. Leopold Mambourg, Lancaster, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 9/20/26. A receptacle containing a mass of molten glass, means for drawing a sheet therefrom, a roll over which the sheet is deflected into a horizontal plane, a hood arranged over the receptacle and adapted to protect the sheet from the atmosphere during its formative period, and heat absorbing means arranged between the hood and said roll.

PROCESS OF DRAWING SHEET GLASS. U. S. 1,761,198. June 3, 1930. John L. Drake, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 6/21/26. The process of producing sheet glass from a mass of molten glass, consisting in drawing a tapered sheet therefrom, and then contacting with and deflecting the sheet into a plane different from the plane in which the sheet is drawn, said deflecting means being arranged relatively close to the molten mass when a relatively thick sheet is desired and relatively far away therefrom when a relatively thin sheet is desired.

CONNECTION FOR WOVEN-WIRE CONVEYERS. U. S. 1,769,901. July 1, 1930. Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn. Filed 12/28/28. In a helically woven wire conveyor in which there are a plurality of sections, a plurality of connecting wires connecting each pair of adjacent sections, the connecting wires having overlapping portions.

APPARATUS FOR MANUFACTURING SHEET GLASS. U. S. 1,769,451. July 1, 1930. Herman Mullensiefen, Witten-Crengeldanz, Germany. Filed 7/13/29 and in Germany 7/18/28. An apparatus for manufacturing sheet glass, comprising a body formed with an elongated slot and adapted to float on the body of glass, said body being formed with bores disposed transversely of said slot, means for drawing a band of glass through said slot, means for supplying wires through said bores and into the band of glass, and means for preventing access of the molten glass to the wires being supplied to said bores.

MACHINE FOR FORMING HOLLOW GLASSWARE. U. S. 1,759,210. May 20, 1930. Leonard D. Soubier, Toledo, O., assignor to Owens-Illinois Glass Company. Filed 1/18/28. An object is to overcome the tendency for the comparatively hot molten glass forming the interior of the parison to force its way upward, breaking through the chilled upper layer and spreading said chilled glass outward against the side walls of the mold. Provision is made for exhausting the air from the space above the charge of glass in the mold, concurrently with the application of air pressure through the lower end of the mold for expanding the parison. The air pressure above the glass being thus removed permits the upper chilled surface portion of glass to move upward in the mold as the parison expands, without being spread or distributed over the side walls. A more even distribution of glass is thus obtained.

MACHINE FOR MAKING SPHERICAL GLASS BODIES. U. S. 1,761,623. June 3, 1930. John F. Early, Clarksburg, W. Va., assignor to the Akro-Agate Company, Akron, O. Filed 3/22/26. In a machine for manufacturing spherical glass bodies, a pair of oppositely arranged rolls having opposing helical peripheral grooves; means for simultaneously rotating said rolls upwardly and downwardly at their respective working points; and means effective from the beginning of the formation of each article for causing the article being formed to rotate positively about constantly changing axes, said means comprising arranging the groove on the upwardly moving roll to have a lead on the groove on the downwardly moving roll.

OPTICAL GLASS. U. S. 1,765,287. June 17, 1930. Murray R. Scott, Rochester, N. Y., assignor to Bausch & Lomb Optical Company. Filed 6/11/28. A dense barium crown optical glass which is resistant to tarnishing comprising over 25 percent of barium and under 5 percent of a zirconium compound.

GLASS-FORMING MACHINE. U. S. 1,764,361. June 17, 1930. Leonard D. Soubier, Toledo, O., assignor to Owens-Illinois Glass Company. File 11/15/26.

GLASS-FORMING MACHINE. U. S. 1,764,268. June 17, 1930. Richard La France, Toledo, O., assignor to Owens-Illinois Glass Company. File 11/1/26.

GLASS-BLOWING MACHINE. U. S. 1,764,360. June 17, 1930. Leonard D. Soubier, Toledo, O., assignor to Owens-Illinois Glass Company. Filed 10/2/22.

METHOD OF DELIVERING AND SHAPING MOLTEN GLASS. U. S. 1,763,968. June 17, 1930. George E. Howard, Butler, Pa., assignor to Hartford-Empire Company. Filed 5/25/21. Temporarily applying a force to the lower portion only of each mass, after detachment, to retard it sufficiently to prevent substantial elongation thereof, and receiving the said mass in a mold.

COOLED ROLL FOR PRODUCING SHEET GLASS. U. S. 1,763,689. June 17, 1930. John L. Drake, Toledo, O., assignor to Libbey-Owens Glass Company. Filed 9/21/27. In sheet glass apparatus, a roll having an opening therethrough, said opening being of such a nature that the wall of the roll becomes progressively thicker from its center towards both ends thereof.

GLASS-CUTTING APPARATUS. U. S. 1,764,966. June 17, 1930. Alfred M. Mazer, Jeannette, Pa. Filed 5/15/25. Means for supporting the glass, a plurality of cutters arranged above said supporting means, a separate electro-magnet associated with each cutter, and a keyboard connected with said electro-magnets for controlling the movement of said cutters.

METHOD OF OPERATING SHEET-GLASS COOLERS. U. S. 1,759,226. May 20, 1930. John L. Drake, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 10/4/26. The process of absorbing heat from a mass of molten glass or from a newly formed glass sheet consisting in passing a stream of oil through a metallic casing in proximity thereto but out of contact therewith, and in maintaining the temperature of the oil in excess of 212° Fahrenheit.

METHOD OF OPERATING SHEET-GLASS COOLERS. U. S. 1,759,227. May 20, 1930. John L. Drake, Toledo, O., assignor to Libbey-Owens Glass Company, Toledo, O. Filed 11/9/26.

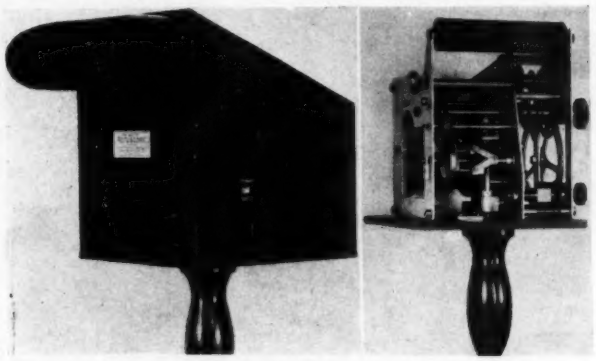
Ashdown Rotoscope "Gears Up" Observers' Vision

The Ashdown Rotoscope, invented by A. J. Ashdown, London, and manufactured in England is an instrument operating on the Stroboscopic principle by means of which the observer's vision is geared up to the speed of any rapidly moving object.

With it, periodic motion, whether rotary, oscillatory, vibratory or reciprocating, can be observed and studied, and the exact speed of the moving object can be determined without physical contact of any kind with the object.

The Rotoscope actually makes a slow-motion camera of the observer's eye, by giving a direct view, without photography. Slow motion study and exact timing at any speed from 100 to 40,000 movements per minute can be accomplished.

The instrument is compact and light, weighing only six pounds. With it the observer is able to make readings under practically any working conditions and without the aid of special illumination. It is operated by clockwork and requires no electrical connections. The operator simply holds the instrument in his left hand with



THE ASHDOWN ROTOSCOPE AND ITS MECHANISM

the shutter apertures to his eyes and controls the speeds with his right hand. By setting the speed of the shutter at exactly the speed of the moving object, the latter appears to be absolutely stationary. Its speed can then be read on the side of the instrument. By increasing or decreasing the shutter speed slightly, slow motion study can be achieved.

Since the introduction of the Rotoscope in England about four years ago it has, it is stated, been adopted by hundreds of the leading manufacturers, technical schools, government departments and research associations throughout England and Europe. Its applications in industry are almost endless, including the study and timing of gears, ball and roller bearings, springs, cams, valves, chain and belt drives, grinding wheels, bobbins, spindles, high-speed tools, in fact—any rapidly moving parts—without dangerous or undesirable contacts. It is useful for purposes of synchronization; for the determination of speed losses from friction or slip; for the observation of vibration and deflection; in fact, for the detection and elimination of the many mechanical troubles which hinder rapid production.

If a view is taken through the Rotoscope of, say, an aeroplane propeller at 2,000 r.p.m.; a shaft at 500 r.p.m.; a reciprocating cam at 1,200 up-and-down movements per minute; a grinding spindle at 13,750 r.p.m.; a fly's wings at 27,000 beats per minute, a chain at 1,500 f.p.m.; dust-laden air passing through a chamber, etc., etc., the respective motions would come to apparent rest in any position. The speed in each case would be exactly determined by reference to the indicated speed of the instrument; i.e. without physical contact of any kind having been made with the moving object.

The chief feature of the Rotoscope is the rotary shutter or "sight gear" which is capable of giving as many as a thousand glimpses per second each less than one fifty-thousandth part of a second duration. This ultra-rapid succession of glimpses, by retentivity of vision, blends into a continuous sight impression. The speed of the shutter can be varied by rapid adjustments with a tiny five-speed gear box. Fine adjustment speed control is thence secured by means of a special centrifugal governor—varying the speed by refinements of one in ten thousand. Not only is it possible to set the Rotoscope at practically any speed up to 40,000 per minute, thereby making the moving object appear to be at rest (presuming its speed to be constant), but by a slight movement of the controller, to set it at a speed either minutely in excess of or below the speed of the observed object.

The speed of motion of high speed grinding wheels or practically any other moving machinery can be secured without dangerous or undesirable contact. It is claimed that perfect synchronism can be checked between two or more objects and their difference of speed determined to within one part in ten thousand. This instrument is said to be of inestimable value for making studies of high-speed machinery, lubricating problems, etc. This apparatus it is said is built to assure durability, costs nothing to operate, has nothing to wear out. The cost of the Ashdown Rotoscope which is being offered to the American trade by Livingston & Southard, Inc., 17 Battery Place, New York, is less than three hundred dollars.

Heat Resistant Alloy Applicable to Glass Plants

Development of a heat and growth resistant alloyed cast iron which is useful in glass making and ceramics has been reported to the twelfth annual convention of the American Society for Steel Treating, held in Chicago, September 22-26.

In a paper, "A Corrosion and Heat Resistant Nickel-Copper-Chromium Cast Iron," J. S. Vanick and P. D. Merica of the International Nickel Company have summarized laboratory and field tests dealing both with the production and application of this material, known as Ni-Resist.

The hot sections of glass annealing furnaces, it is pointed out, have been built in this material. The application requires dimensional stability or resistance to deformation or warpage under heat, and at a temperature of 1,100 to 1,400 degrees F. the alloyed material it is asserted has outlasted plain cast iron as much as ten to one in this service.

The authors have received reports that in the ceramics industry castings of this material, when used in enameling stove parts, has lasted from six to seven months as compared with ten days for ordinary cast iron. In enameling bathtubs alloyed cast iron supports have lasted from six to seven weeks as compared with four to seven days with ordinary cast iron supports.

It has been further demonstrated that this material, except for being considerably more corrosion and heat resistant than plain iron, is in general quite similar to it in characteristics and in fabricability. Thus, it can be produced in the ordinary cupola, and can be molded, cast, and handled in foundry and machine shop under conditions similar to those in practice for gray iron.

Books and Bulletins

FACTORY DESIGN AND EQUIPMENT AND MANUFACTURE OF CLAY WARES. By T. W. Garve. Published by T. A. Randall & Co., Inc., Indianapolis, Ind., 1929. With a foreword by Ellis Lovejoy.

This 300 page book is a very useful addition to the systematic treatment of ceramic wares. It covers in a very excellent way the choice of sites, machinery, and handling methods generally, when various classes of clay wares are to be exploited. There are many practical hints on a thousand and one little difficulties, and some brief but useful notes on the design of buildings. The field covered is naturally much wider than that to which most readers of THE GLASS INDUSTRY must apply themselves, and the detailed problems therefore must receive scant notice, but it is certain that many glass men are not sufficiently familiar with a wide enough range of clay working processes.

The reviewer found the English a little distracting at times, but this seems to be the only serious weakness of the book. It is well illustrated, and provided with a useful index. We wish there were more books like it.—*F. W. P.*

HAND TOOL ACCIDENTS, by Robert B. Northrup, Inspector of the Bureau of Industrial Hygiene of the New York State Department of Labor. A startling fact has been disclosed by the Bureau of Industrial Hygiene of the New York State Department of Labor. This is disclosed in its bulletin on Hand Tool Accidents just issued. By actual tests made at New York University, it has been discovered that the low priced tool is very extravagantly high in cost especially when the expense involved in accidents is considered. The University made a practical test and found that the cheap hammer costs nearly 22 times as much as the expensive hammer in point of service.

Glass Factory Equipment and Supplies

New Device for Installing Windshield Glass

A new device for use when installing windshield glass has been brought out by the Speedyklamp Manufacturing Company, 1031 Patterson Road, Dayton, O., of which Ralph Cloppert, inventor of the device is manager.

For some years Mr. Cloppert has been associated with the auto glass industry, as Dayton representative of the IXL Glass Corporation. During his extended contact with garage and glass houses he worked out the idea for the new device.

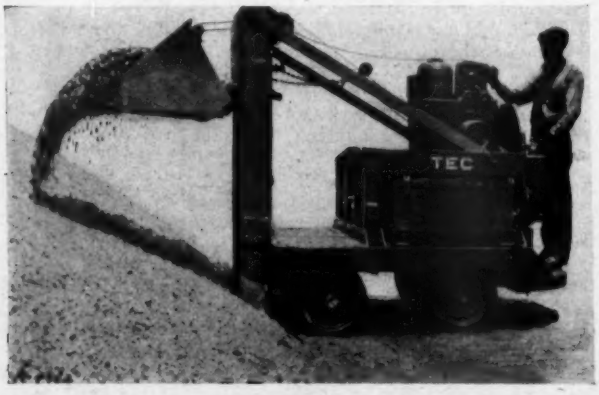
This apparatus is small, compact, of all metal construction, the use of which it is asserted makes possible the installation of automobile windshield glass with minimum time and effort. In tests conducted by the inventor it was found that the removal of old glass and the placing of new can be completed in eight minutes.

According to Mr. Cloppert in changing auto glass it is not necessary to remove the entire windshield frame from the car. By a simple operation of the device the windshield frame is spread so the old glass can be removed quickly and new glass easily replaced. With another slight turn of the apparatus the entire windshield, it is said, is brought back into proper place by one man.

An extension which will permit the opening of the Speedyklamp to 48 inches has been developed, also a Speedyklamp salvage saver, a small appliance which removes glass from the bottom channel of body lights of automobiles and saves in salvage and labor. These accessories will be available to purchasers of the Speedyklamp, but will be useless without it.

New Four-Wheel Drive Shovel Truck

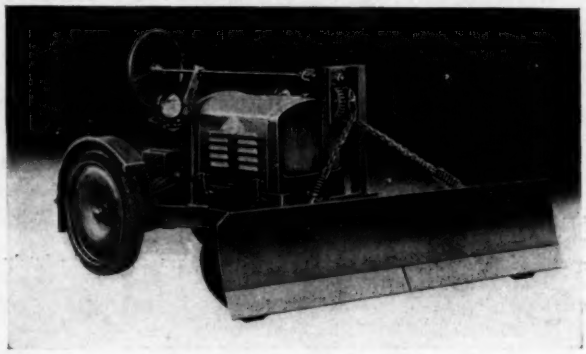
An electric four-wheel shovel truck of entirely new type for handling bulk materials has been added to the line of the Terminal Engineering Company, 17 Battery Place, New York. The machine is small enough to work inside a box car and yet dig and carry one-ton loads. The shovel, it is said, will unload the box car every hour and carry its loads to almost any desired place indoors or outdoors. Because of the four-wheel drive with separate motor for each wheel, the machines have the necessary tractive power for pushing their shovels into a pile of material and for work in slippery places and in sand or snow. Their traveling speed is 10 miles per hour empty and 8 miles loaded. The loads are all carried in an overhung position counterbalancing the weight of the battery hoist, etc., at the opposite end of the frame. With this truck the heavier the load the greater the traction. The single hoist unit controls all the functions of the bucket. An automatic stop of the upstroke speeds up the operations on short haul work and acts as a safeguard. The turning radius of the truck is exceptionally short because all four wheels steer. The shovel is operated from a storage battery in a steel compartment placed over the wheels of the driver's end which helps as a counterbalance. Quick and easy interchange of battery is provided for. Safety features include two sets of brakes that are mechanical on two wheels and electrical on four wheels, operating independently from the foot pedal and speed controller respectively. The operator's hands are protected from injury because all controls are within the outer edges of the truck at all times, the steering being done by wheel rather than a handle bar.



SHOWING A NEW FOUR-WHEEL DRIVE SHOVEL

Getting Ready for the Coming Blizzards

The economic advantage of prompt removal of snow from platforms, runways, yards and alleys is so obvious that even plants of moderate size may be interested in a new implement made by the Clark Tructractor Company, Battle Creek, Mich., for economical snow removal. This is the "Clarktor" snow plow, built on the "Clarktor" tructractor chassis. The adjustable blade, always under the operator's control, has a renewable cutting edge of special



"CLARKTOR" SNOW PLOW

hardened alloy steel and when lowered rides on two steel buttons which prevent the edge of the blade from striking minor pavement irregularities. The plow assembly is hung on heavy springs in the supporting chains. Road shocks it is claimed are completely absorbed. The 82" blade cleans a path 74" wide.

The plow assembly is easily removed and the Clark rotary broom substituted for use indoors on aisles and other passage ways.

The tractor is four-wheeled and gas-powered. It has a turning radius of 108" and develops 3,600 lbs. draw bar pull in low gear. When not in service as a sweeper or as a plow, the "Clarktor" is available for a multiplicity of pulling and pushing jobs.

For loading snow into trucks the new "Clarktor" power shovel may be utilized. It will handle fast any loose, flowing materials such as sand, bulk cement, soft coal, ashes, and similar products.

Industrial Publications

The Era of Automatic Control. The Brown Instrument Co., Philadelphia, Pa., issued a new catalog featuring Brown indicating, recording and automatic control pyrometers. It contains 104 pages with 141 illustrations, many of which are in two or more colors. A comprehensive resume of the theory and practice of applied pyrometry is presented, together with descriptions and illustrations of all instruments, thermocouples, protecting tubes and other required equipment.

New Turbine for Driving Small Pumps and Fans. A new small mechanical-drive noncondensing steam turbine for driving centrifugal pumps, fans and similar industrial equipment operating in general at speeds between 1,750 and 3,600 r.p.m. has been announced by the General Electric Company.

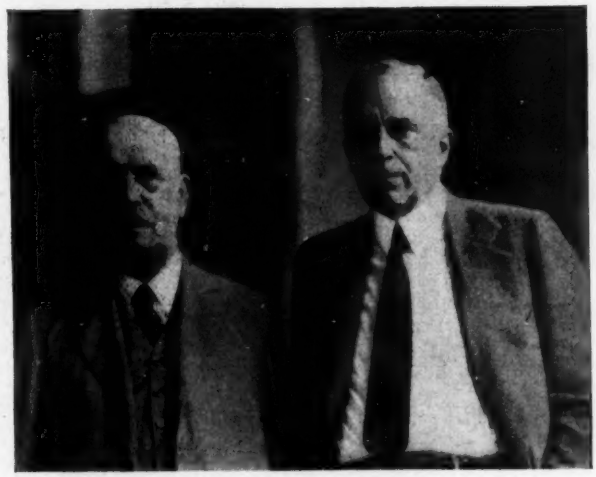
The Glass Container Association

Semi-Annual Meeting

The semi-annual meeting of the Glass Container Association of America was successfully held on September 17, 18 and 19 at the Hotel Traymore, Atlantic City, New Jersey.

President L. S. Cunningham called the first general meeting to order on the morning of Thursday, September 18. In a few well directed words he paid his respects to Mr. Heuisler, the past president, and in stating his opinion of present economic conditions said that in his long career he had seen many ups and downs and that present conditions in his estimation were approaching a termination. He touched upon the good work being done by the various committees and urged further cooperation with them. He further urged that a particular effort be made for new and more business as this was the psychological time to apply the screws and make things move.

E. G. Ackerman, in the capacity of assistant business manager, reported the progress of the traffic and other committees in furthering the cause of the glass container by striving for just legislation in regard to traffic and tariff rates.



L. S. CUNNINGHAM
President

CHARLES R. STEVENSON
Business Manager

Victor L. Hall gave a report on the treasury.

The report of the Committee on New and Increased Uses brought out the interest aroused among oil companies in the project of selling oil in sealed glass containers.

Karl T. Ford, director of research, told the association something of the work being carried on in the laboratory. Principal among the activities carried on during the year was the adding of tomato juice to the list of foods packed in glass, this product now being packed in glass containers by some of the largest concerns.

A report on the successful progress of the advertising campaign of the Glass Container Association was made by I. R. Stewart and Donald McConaughy, the latter of N. W. Ayer & Son, Inc., advertising consultants of the Association.

Some interesting aspects of the campaign which showed its effectiveness was the reading of a few replies from questionnaires sent out to packer, retailer and salesman alike whose consensus of opinion in answering the different questions asked them was that the aggressive advertising efforts of the association were going far to make the public "glass conscious" and was considered a successful effort worthy of continuance.

The American housewife was consulted via a "blind" questionnaire. Of the 12.9% responding to the letter, 57% believed they got better quality foods in glass, 44% of the housewives stated they were buying more foods in glass containers now than they were a year ago, and upon being asked if the color advertisements describing the advantages of glass containers (as run in the *Saturday Evening Post*) had interested them, 68% replied in the affirmative, 30% in the negative and only 2% had not seen the ads at all, a truly remarkable percentage.

Report of statistics was made by Victor L. Hall.

Col. George Roth, Harvard Economics Society, spoke to the members on "Commodity Prices and Prosperity." In bringing out his subject Col. Roth stated that the late market crash was inevitable as the market at the time had long outlived its normal position. Production, which had been already 10% above normal, was speeded up 10% more, or 20% above normal, at which fever pitch it was impossible for it to carry on indefinitely without ill effects. Col. Roth stated that many had believed that the law of business cycles had been crushed and prosperity could have gone on forever. In defining prosperity he said it was a condition of prevailing good credit, good production, normally increasing commodity prices, good transportation conditions and wages which afforded more than the necessities of life.

Col. Roth pointed out that commodity prices have gone below those of 1924 and approach those which existed in 1921. They have dropped 20% since this time last year. From 1896 till recently there had been an increase in commodity prices. If the war had not occurred they would be 50% above 1913, a period of normal ascending prices.

In determining the factors which will govern commodity prices in the next 8 or 10 years, Col. Roth quoted Joseph Kitchen, the English expert, who states that a 3% increase in gold per annum is necessary for normal growth. Rapidity of credit and the ability of production to quickly correct its excesses, will also influence the trend of commodity prices. The reason for commodity prices righting themselves is that we are not in danger of a decrease in gold as a 2½% increase is expected which is nearly normal. A 35 to 50% increase in commodity prices may be looked forward to with a reasonable amount of assurance in the next 10 years or so.

While no great hope for an exceptional comeback to former prosperity in the next 3 or 4 months is harbored, neither need we fear the bottom dropping out of business. The bottom is believed to have been struck in prices and the "chills and fevers" over the fall will bring a better condition in '31.

It is possible for the United States to enjoy prosperity without it being world wide. This was the case here from 1922 till about two years ago, at which time Europe first experienced prosperity.

In conclusion, Col. Roth stated that we can continue in relative prosperity such as enjoyed now on general merchandise and general manufacturing.

At this point the meeting was adjourned in time for luncheon.

The Cap and Closure section of the Association held a meeting in the afternoon. At night an informal banquet was held which was voted a success by all in attendance with good food and entertainment serving to put the right social touch to the meeting.

FRIDAY MEETING

The concluding session on Friday was devoted in the main to the hearing of reports of the various committees.

Mr. C. G. Hicks, editor of *The Glass Container*, the official publication of the Association, gave a resumé of the work being done in that department in spreading the gospel of "See What You Buy, Buy in Glass."

Charles R. Stevenson, business manager of The Glass Container Association in summarizing, stated that the various departments have been functioning well, citing as an example the traffic department, which has done good work in half a dozen cases. Mr. Stevenson stated that industry in general had shown a recession in volume of 11.25 per cent, with a decline of 25 per cent in the basic steel industry. On the other hand, the glass container industry fell off only 4.3 per cent in shipments and 2.2 per cent in volume of orders in the first eight months of 1930. He ventured his opinion that the first quarter of next year will be just as hard as now, reaching an accumulative peak of unemployment. He went on to say that the glass industry as a whole has stood up remarkably well during the present strenuous times. Concluding with the warning to glassmen to further organize to protect against possible future losses, he said that what decisions were made now and what steps were taken would determine the trend of the glass industry for 1931.

The meeting then was adjourned.

A Glass Section meeting was held in the afternoon, which brought the convention to a close.

The Glass World and What It Is Doing

News of the Industry

Glass a Large Item in Furniture Costs

To the Editor of THE GLASS INDUSTRY:

Many furniture manufacturers advise us that glass is one of their chief purchases.

In view of this fact, it is of importance to the sales managers, advertising managers and sales promotion managers of makers of glass to know just where all of those establishments manufacturing furniture are located. The enclosed article[1] gives this information in greater detail than has ever before been made public by the Census Bureau, and should prove in the nature of a handy reference to those sales executives of glass manufacturing concerns who are interested in reaching the furniture market.

Yours sincerely,
(signed) EDWARD R. DEWEY,
Chief Business Organizations Service
Bureau of the Census, Department of Commerce.
WASHINGTON, D. C., August 30, 1930.

The preliminary report for the furniture industry for 1929 will be published by the Census Bureau within two or three weeks after all the furniture manufacturers have filed their returns with the Bureau. This report will also be sent, without charge, to those who ask for it.

The furniture industry, which is an important industrial market, is scattered throughout the country, factories being located in more than 450 counties in 42 States. Yet more than half of the 3,224 furniture-making establishments are located in 56 counties each having ten or more such factories.

Information concerning the location, not only of the furniture industry, but also of all industries, by counties, has recently been prepared by the Census Bureau and has been published by the Bureau of Foreign and Domestic Commerce in a book entitled "Market Data Handbook of United States" (available from the Superintendent of Documents, Washington, D. C., for $2.50). This book shows that there are in the United States 3,224 furniture establishments, located in 468 counties, each of which produced commodities valued at $5,000 or more in 1927.

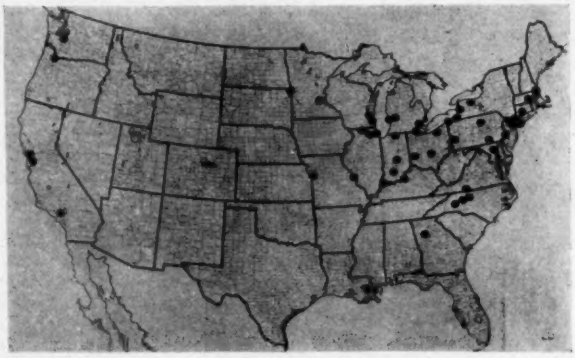
EDWARD R. DEWEY

The Census classification "Furniture" covers all classes of wood and metal furniture, including hammocks, furniture ornaments, store and office fixtures, show cases, display cases, wall cases, and cabinets.

The number of counties in each State having furniture establishments and the total number of establishments is shown. Not only are the furniture factories concentrated in a relatively small number of the 3,075 counties in the country, but also that a small proportion of the counties contain the bulk of the establishments.

Of what practical use is such information, prepared by the Bureau of the Census, to the manufacturing establishments selling to the furniture industry? First and foremost, it can be seen at a glance that there are more than 2,500 counties in the United States in which no furniture manufacturing establishments are found, and in which it is therefore useless to look for business from this industry. Next, assuming that all furniture manufacturing establishments are a potential market for the goods that the manufacturer has to sell, he can compare the number of customers which he has in each county or in any particular county having furniture establishments with the number of establishments shown.

[1] Lack of space unfortunately prevents publication of Mr. Dewey's article complete, but copies of it, including a tabulation by states, counties and number of establishments may be obtained gratis by addressing Edward R. Dewey, Chief, Business Organization Service, Bureau of the Census, U. S. Department of Commerce, Washington, D. C.



COUNTIES DESIGNATED BY THE DOTS
had ten or more establishments engaged primarily in the production of furniture in 1927.

Mirror Industry Again on Upgrade
Production in 1929 Increased 1.2% Over 1927

BY JOHN F. DALY[1]

The value of mirrors and other products shipped or delivered in 1929 by mirror manufacturers amounted to $31,796,808, an increase of 1.2 per cent as compared with $31,424,943 reported for 1927, the last preceding census year.

Last year's total production was made up as follows: framed plate-glass mirrors, $5,195,461; unframed plate-glass mirrors, $14,902,829; framed mirrors, other than plate-glass, $807,267; unframed mirrors, other than plate-glass, $2,530,239; mirrors and other glass, not reported in detail, $826,271; other products $7,534,741.

The mirror industry as defined for census purposes, embraces establishments engaged wholly or principally in the manufacture of mirrors, both framed and unframed, such as pier glasses, mantel mirrors, hall mirrors, mirrors for show cases and automobiles, and hand mirrors.

There were 287 establishments engaged primarily in the production of mirrors last year, an increase of 14.8 per cent as compared with the 250 reporting in 1927. These manufacturers gave employment to 4,700 wage earners, to whom they paid $6,773,409 in wages, which represented increases of 9.1 per cent and 6.5 per cent, respectively, as compared to 4,309 wage earners employed and $6,360,813 in wages paid in 1927.

Materials, containers, fuel and electric purchased cost the manufacturers $15,951,840 last year, a decrease of 1.5 per cent as compared to $16,188,614 expended in 1927, despite the increase in the value of products produced. The value added by manufacture, however, was $15,844,968, an increase of 4 per cent over the total value added in 1927.

Apparently the mirror industry is now again on the upgrade and has recovered from the slight slump shown in 1927 as compared with 1925 when the production amounted to $34,948,504. In 1923, the production amounted to $33,467,973, a 100 per cent increase over the 1921 production which totaled only $16,739,545. However, 1921 was an abnormal year and the production was a decline of about $4,000,000 as compared with the 1919 total of $20,830,775.

[1] Assistant Chief Statistician for Manufacturers, United States Bureau of the Census.

Tariff Commission Orders Investigations of Glass Costs

Shortly after the adoption of the tariff bill in June, the Tariff Commission on August 25 ordered an immediate investigation of duties on 27 products. The commission is authorized by the new law to act upon rates under the flexible provision at the request of Congress, and any interested party may initiate his own investigation. More than 100 inquiries have been asked by resolution of Congress. Some of the rates were attacked as being too high and others as too low. Increases or decreases of not more than 50% based upon the different production and other labor costs here and abroad may be recommended by the Commission to the President for his acceptance or rejection.

Some of the products to be investigated are as follows: Cylinder, crown and sheet glass by whatever process and for whatever purpose used, laminated products of which a synthetic resin or resin like subject is chief binding agent in the sheets or plate, lumber and timber of fir, spruce, pine, hemlock or larch.

Public hearing No. 20 on window glass, including cylinder, crown and sheet, is to be held at the office of the Commission at Washington, D. C., or at such other place or places that the Commission may designate on the dates hereafter to be fixed, of which public hearing notice shall be given by posting a notice thereof for 30 days at the offices of the Commission in Washington and New York and by publishing once each week for two successive weeks in *Treasury Decisions* and *Commerce Reports,* which publications are obtainable from the Superintendent of Documents or the Government Printing Office in Washington, D. C.

Investigation No. 30 on laminated products will follow a similar course.

Investigation No. 35 of table and kitchen articles and utensils wholly or in chief value of glass blown or partly blown, regardless of composition, decoration or further treatment will be held on a date hereafter to be fixed, of which public notice will be given.

New Laminated Glass Development

Manufacture of two new products known as Artriplex and Ad-Triplex making possible the use of color and design in laminated glass, has been announced by the Triplex Safety Glass Company of North America. Their production follows basically the same process used in the making of non-shatterable windshields.

Two layers of selected glass, cleaned and coated with an adhesive, and a single layer of plastic material are brought together under high pressure and elevated temperatures. The color is introduced by means of a colored plastic layer. By this method, the durable polished surface of glass is strikingly combined with the brilliance of the color contained in the plastic.

There are four distinct processes for producing the colored laminated glass. The first is the use of celluloid or plastic which has been colored previous to lamination. By this method, there is no limit to the number of colors or color combinations that can be produced. This single process permits the reproduction of stained glass effects, mottles, marbles, inlay woods, ordinary wood grains and inlaid pearls.

The second process involves direct printing on the plastic layer. The colored background is got by the use of color in the plastic as previously described. The product thus obtained is known as Ad-Triplex and is planned for extensive use in the advertising field and in the manufacture of signs of every description. Line and mechanical designs of any sort and in any color can be reproduced.

Lithographs are transferred directly to the plastic in the third process by the application of heat and pressure. After the lithograph has been literally made a part of the plastic layer, the usual lamination procedure is followed bringing about the permanent sealing of any desired design in any color or colors between two layers of glass. A flower, for example, can be displayed in all of its natural colors against any manner of background. Snake skin effects can be exactly reproduced.

The last process has been evolved from a development of silver and dark mirrors in the laboratories of the Triplex Company. The picture or design drawn by an artist is transferred to the mirrored glass by a process involving photography and a chemical preparation of the glass surface. The design obtained in this manner is then etched on the glass and laminated with a plastic layer and another sheet of glass. The design then stands out clearly against a background of a silver or dark mirror. Any design or picture that can be drawn may be thus reproduced.

Artriplex and Ad-Triplex have many advantages, the principle one undoubtedly being the permanence of the design. Due to the actual lamination of the plastic containing the design between two layers of glass, it is immune to damage from any source. It will retain its original brilliance of color indefinitely beneath a polished glass surface. The number of colors or designs which may be used is practically limitless.

Because of the wide range of color and design, the uses of these two products are extensive. They can be divided roughly into three groups: decorative, structural and mechanical.

Decoratively, Artriplex can be used for table tops, all sorts of trays, toilet articles, plaques, coasters and desk tops. Structurally, it can be used for wall panelings, hospital fittings, radio cabinets, decorated mirrors, soda fountains and for any construction work where a marble effect is desired.

Ad-Triplex is suitable for all manner of mechanical display. Advertising matter and signs of every description can be displayed with maximum permanence of design and practical durability. The printing and color under the hard, polished surface of the glass surface take on a clearness and brilliance not obtainable from any process other than this.

Safety Congress at Pittsburgh

The Nineteenth Annual Safety Congress of the National Safety Council is being held as we go to press at the William Penn and Fort Pitt Hotels, Pittsburgh, Pa. In view of the growing interest of all industries in safety problems this annual meeting is becoming of greater importance every year. It is attended by many of the safety experts from the largest and most progressive plants in various industries including that of glass manufacturing.

The meetings, which begin with an accident prevention equipment manufacturers' dinner on Sunday evening, September 28th, and continue through the week to and including Friday, October 3, will discuss innumerable subjects relating to the development of safety campaigns in industrial plants.

The engineering section of American Society of Safety Engineers of which C. B. Auel of the Westinghouse Electric and Manufacturing Company is general chairman will hold meetings daily. A banquet at which Rear Admiral Richard E. Byrd will be present is scheduled for October 1st.

H. K. Ferguson, President of the H. K. Ferguson Company, Cleveland, O., is on the program and will give an address before the construction section of the National Safety Council on a subject relating to safety in the construction industry.

In the industrial health section on Monday afternoon, September 29th, at the William Penn Hotel, will be heard, among others, an address by Dr. Jesse E. Ambler, chief surgeon, Pittsburgh Plate Glass Company, Ford City, Pa.

Chapman-Stein and Surface Combustion Companies Combine

The Chapman-Stein Company, Mt. Vernon, O., and the Cooper-Bessemer Corp. have been merged with the Surface Combustion Company, Toledo, O. Both companies have for a long time been engaged in building fuel burning equipment. The Chapman-Stein Company manufacture glass melting furnaces, gas producers, etc. They have also manufactured a large amount of steel mill equipment, such as open hearth furnaces, billet heating furnaces, etc. All the equipment of the Mt. Vernon plant will be transferred to Toledo, it is said, and the executive and engineering staffs also will be located in that city.

Present Wage Scale at Toledo to Be Continued

Libbey-Owens-Ford Glass Company officials and representatives of the Window Glass Cutters League met in September for a three-day wage conference, but no new agreement as to wages was reached. An understanding was therefore brought about that the entire present wage scale be extended until such time as some different agreement can be arranged.

Corning Glass Plants in Operation

Commenting on newspaper reports to the effect that some of the Corning Glass Works factories had discontinued operations, W. H. Curtiss, vice-president of the company, stated on September 19th that while it is true that the Rhode Island and Fall Brook Divisions of the Corning Glass Works had been shut down temporarily in order to avoid accumulation of stocks of finished goods in a period when orders and shipments were rather low, business has improved sufficiently so that both the Rhode Island Bulb Division and the Fall Brook Tube Division will reopen on October 1st with one tank furnace operating in each division. The Wellsboro plant equipped with the famous 399 bulb making machine continues to operate with one furnace.

Accident at Berkeley Springs

A report from Berkeley Springs, W. Va., states that on the night of September 22 three large sand bins at the Berkeley Glass Sand Company's plant gave way and crashed into the factory buildings. It was estimated that the bins contained 1,200 tons of rock. Three large power transformers were practically destroyed. The loss was estimated at $20,000. Local company officials the next day were unable to state whether the plant would be abandoned or rebuilt.

Production Increasing

Numerous reports of plant re-openings after shutdowns for vacations, repairs, etc., have been received during the last few weeks. These include the Eden plant of the Knox Glass Bottle Company, the Oil City Glass Bottle Company, the Foster Forbes Glass Co., Marion, Ind.; Marienville Glass Company, Marienville, Pa.; the Paramount Glass Co., St. Marys, W. Va.; Pennsylvania Bottle Company, Sheffield, Pa.; Weston Glass Company, Weston, W. Va.; National Plate Glass Company's factory at Ottawa, and a number of others.

Belgian Window Glass Conditions

According to *Commerce Reports*, September 22, 1930, the window-glass industry is still operating at 40 per cent of capacity, but the market tone has been favorably influenced by the new announcement regarding the successful conclusion of the Fourcault combine. An important reduction in stocks of low quality glass is reported, but French competition is keen in the better grades. The Fourcault producers have proposed a 20 per cent wage cut to improve the situation of the industry, but will possibly compromise on 10 per cent. The plate-glass situation remains unchanged.

Old Plant May Re-open

The old Liberty Glass plant at Northview, Clarksburg, W. Va., may be opened up shortly. A request for the opening of a street above the railroad tracks brought the fact to light that W. M. B. Sine of the Adamston Flat Glass Company and a group of other men have formed an organization to operate the factory and that 125 men will be employed at the start of operations.

International Glass Cartel Being Organized

The information of a cartel of Belgian glass manufacturers is semiofficially announced, following on the adhesion to the scheme of the firm of Henri Labert, the most important glass manufacturer who has hitherto been holding out. It is considered in Belgium that this is a prelude to the formation of an international glass cartel.

H. G. Dixon Succeeds to Father's Position

H. G. Dixon, president of the H. L. Dixon Company, Pittsburgh, Pa., has been elected a director of the Citizens State Bank of Dormont, Pa., a suburb of Pittsburgh, where the former president, Henry L. Dixon, had his home.

Exclusive Sales Rights for Vacuum Machine

The O'Neill Machine Company, Toledo, O., announced on September 15, and again state in their advertisement in this issue, that the company is now sole sales representative for the O'Neill Vacuum Machine.

H. W. Baque Joins Cohart Organization

H. W. Baque, recently with the Woods-Lloyd Company of Pittsburgh, has joined the sales organization of the Corhart Refractories Company on the staff of Fred S. Thompson, general sales engineer.

Trade Activities

Weston Glass Company, Weston, W. Va., resumed operations several weeks ago.

The **Creighton plant** of the **Pittsburgh Plate Glass Company** during September was operating in full.

Henry T. Hellmers has become connected in the capacity of chemist with the Cambridge Glass Company, Cambridge, Ohio.

J. J. Kean, 601 Wilkinson Street, Shreveport, La., is reported contemplating the establishment of a glass plant, possibly at Jackson, Miss.

Flat Glass Specialty Company, Clarksburg, W. Va., has been chartered with a capital of $50,000. P. H. White, 318 Rosemont Avenue, is interested.

The Millville Glass Products Corporation, New York, Orem T. Wharton, Dover, Del., agent, has obtained a Delaware charter. The capital is $500,000.

Dowell-Rowland, Youngstown, O., fabricators of glass products, is reported to have started night shift operations because of their heavy volume of new orders.

Charles W. Klein, secretary and treasurer of the Cooperative-Flint Glass Company, Beaver Falls, Pa., has resigned and will be succeeded by his son-in-law, George Merriam.

The Adamston Flat Glass Company, of which G. L. Siegel is Eastern sales agent, has moved their New York office to room 241A, 1 Madison Avenue. Telephone number Ashland 7782.

A. T. McClure Glass Company is the name of a proposed corporation for which a charter has been asked in Pennsylvania. The purpose of the company is to deal in glass, paints, floor coverings, etc.

International Glass Company, Inc., Newark, N. J., has been incorporated by James D. Moorhead, Meyer Appel, and Shirley A. Needleman of New York to deal in glass. Capital 1,000 shares no par value. Their attorney is Warren E. Willis, New York.

The American Society of Mechanical Engineers at their annual meeting on September 23 elected as president a trade journal editor, Roy V. Wright, of the *Railway Age*. W. Trinks, well-known engineer of Pittsburgh, was appointed representative of the American Engineering Council.

The Coppus Engineering Corporation, manufacturers of blowers and turbines for specific industries, Worcester, Mass., announced in September that Martin Van Stappen had been appointed manager of the industrial blowers and turbine department, and Ernest Kundig appointed sales manager of the house heating blower department, as well as export manager of the company.

The United States Glass Company of Pittsburgh, Pa., announced the appointment several weeks ago of J. A. Jones, who has been superintendent of the Gas City plant, to the position of works manager, with headquarters at Pittsburgh. The company operates factories at Pittsburgh, Glassport, Pa., Tiffin, Ohio, and Gas City, Ind. Clifford Gallaher, who was assistant to Mr. Jones at Gas City, has been appointed superintendent to succeed Mr. Jones.

National Plate Glass Company of Ottawa, a subsidiary of the General Motors Corporation, recently announced that H. J. Eckenrode, president and active head of the company, had tendered his resignation September 9 to take effect immediately, and Paul M. Nesbit has been made vice-president and resident manager at Ottawa, Ill. Mr. Nesbit was formerly sales manager of the National Plate Glass Company. William H. Wolff, general superintendent of the company's plants, resigned at the same time. John R. Tyson, for the past two years superintendent of the company's plant at Blairsville, Pa., was appointed to succeed Mr. Tyson. The general offices of the National Plate Glass Company were moved from Detroit recently and concentrated at Ottawa.

The Interstate Commerce Commission has recommended that reparation be made to the Glenshaw Glass Company against the Baltimore and Ohio Railroad for excessive rates charged on glass sand from Berkeley Springs, W. Va., and Hancock, Md., to destinations in the Pittsburgh district. The examiner decided that the rates should not exceed $1.95 per ton. He found that the complainants computed the distance between the Maryland and West Virginia sand banks to Pittsburgh via the Magnolia cut-off, which reduced the mileage.

The Brown Instrument Company, Philadelphia, Pa., announce that George W. W. Cornman, treasurer, and also manager of their service department, is retiring from business after an association with the instrument business for 35 years. Mr. Cornman was formerly secretary and treasurer of the Keystone Electrical Instrument Company and when that organization was absorbed by the Brown Instrument Company he became treasurer and a director of the combined organization. After his retirement on August 8 the service department was put in charge of R. C. Kennan as manager and E. T. Nahill as field supervisor.

The Roessler & Hasslacher Chemical Company, Inc. has announced a number of changes and appointments in personnel: Dr. W. F. Zimmerli, who has been operating with the commercial development division at the New York office, has been appointed head of the commercial development department at Niagara Falls and will make his headquarters at that place. New appointments to the technical staff at the Niagara Falls plant include: Noah S. Davis, Jr., Ph.D., Yale, 1930; Alton Gabriel, Ph.D., Cornell, 1930; H. E. Klein, Ch.E., Purdue, 1930; Lloyd Mann, B.S., Middlebury College, 1930; H. A. McPhail, M.S., Toronto University, 1930; W. T. Rinehart, M.A., Indiana University, 1930; W. B. Tanner, Ph.D., State University of Iowa, 1930; Jane Williams, B.A., Indiana University, 1930; Dr. J. H. Payne, of the Niagara Falls plant, has been assigned a year's leave of absence to complete studies in Germany.

Recent Deaths

Harry O. Brawner

The death of Harry O. Brawner, member of the firm of Swindell Brothers, Baltimore, Md., glass manufacturers, on Monday, August 11, was briefly noted in the September issue. Further particulars are that Mr. Brawner had been a member of Swindell Brothers for over thirty years and had been employed by the company for over fifty years, starting as a clerk at the age of 14. He worked his way up through the various departments until in recognition of his ability he was taken into partnership. As general manager of production he had much to do with the development of glassware for the perfume and toilet preparations trade in which he was particularly interested. Mr. Brawner had married but was a widower and of late years had been living with his son Charles, in Ruxton, Md. Two sons, Charles Swindell and Pierce Henry Brawner, survive him.

HARRY O. BRAWNER

Mr. Brawner was a member of the Baltimore Country Club, Merchants Club of Baltimore and the Gibson Island Club. His favorite recreations were golf and yachting.

Coming Meetings

The Illuminating Engineers Society will hold its 20th annual convention at the Hotel John Marshall, Richmond, Va., October 7 to 10. Many papers on various phases of indoor and outdoor lighting will be discussed. Among others "How Light Affects your Day Lighting," by H. H. Higbie and H. S. Bull, "Energy Measurements in the Visible and Ultraviolet," by Frank Benford and Rachel F. Howe. On Friday, October 10, at 9:30 a. m., an Ultraviolet session will be held and a number of papers presented by well known men including the "Biologically Active Component of Ultraviolet in Sunlight and Daylight," by Dr. W. W. Coblentz of the Bureau of Standards, Washington, D. C. "Erythemal Basis for Dual Purpose Lighting," by M. Luckiesh. At 2 p. m. a paper on Industrial Uses of Ultraviolet, by Dr. E. E. Free and E. C. C. Clark will be presented.

American Ceramic Congress and Exposition, February 23-27 inclusive, 1931, at the Cleveland Public Auditorium, Cleveland, Ohio. Ross C. Purdy, 2525 N. High Street, Columbus, Ohio.

The American Refractories Institute will meet in October at Atlantic City, N. J.

What The World Wants

Specific Inquiries for American Goods Received in the Department of Commerce, Washington, D. C. For further information write the department.

China—47592, Glassware, hotel.

England—47652, Glass, plate, polished.

Panama—47521, Soda-fountain material, such as glass ice cream dishes, spoons, glass jars for use on counter, and syrup jars.

Denmark—47789, Glass, plates, crockery.

France—47756, Glassware.

Inquiries Received

For further information address THE GLASS INDUSTRY.

522. We want to learn how to dissolve or liquefy sodium silicate now in the form of lumps. Who makes suitable equipment?

523. Please put us in touch with manufacturers of equipment for producing high quality ground glass.

524. Can you supply a formula that will cement broken glass so that it will stand the heat of an electric element, similar to that which is used by manufacturers of electric fireplaces.

525. We are looking for a source of supply for a line of cruets, small sets of vinegar and oil bottles about three or four ounces in capacity with handles and with a serving plate, which we can possibly adapt to ecclesiastical purpose. They can be plain, round or ribbed and the stopper does not necessarily have to be cross shape. What we are looking for is probably a pressed glass item cheap in price, ranging from about 10c apiece upward to about 50c apiece, trays for same (accommodating 2 bottles) ranging in price from 10c to 25c.

526. We are trying to locate the manufacturers of a special kind of glass called praseodymium, used in the oil industries for breaking up the sun's rays and also used in optics for adding red, yellow and blue rays to those favoring the blue in color blindness. It is the latter in which we are interested.

Readers Wants and Offers

Address answers to all "keyed" ads c/o The GLASS INDUSTRY, 24 West 40th St., New York

POSITION WANTED—SUPERINTENDENT

Thirteen years' experience in bottle manufacturing, as Superintendent, experienced with all types bottle blowing machines, vacuum or gob-fed, also three years' experience in bottle machine designing. Can also speak French and Spanish, married and have family. Address O2.

SUPERINTENDENT

Well-known middle-west manufacturing concern is looking for an experienced executive to take charge of glass department. The successful applicant should be a man of wide experience in making press and blown ware of various sizes and shapes, some paste mould ware, German and American system, and some iron mould ware. Should also be qualified to assist engineering department in development of blanks. Modern plant. High grade personnel. Excellent working conditions. Steady work. Salary commensurate with ability. In response please give full details as to personal facts, age, experience, salary, etc., in strict confidence. Address O1.

Current Prices of Glass-Making Materials

September 19, 1930

Quotations furnished by various producers, manufacturers and dealers.

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	.46	.46
Hydrochloric (HCl) 20° tanks, per 100 lb		..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.10-.11¾
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	..
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	..
Tartaric	lb.	..	.34½
Alcohol, denatured	gal.	..	.52
Aluminum hydrate ($Al(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.19
Ammonia water (NH_4OH) 26° drums	lb.	.03	.03¼
Antimony, metallic (Sb)	lb.	..	.09½
Antimony oxide (Sb_2O_3)	lb.	..	.09½
Antimony sulphide (Sb_2S_3)	lb.	..	.14
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	47.00	..
90% through 100 mesh	ton	44.00	..
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05-.05½
Barium mixture, glassmaker's, f.o.b. St. Louis	ton	25.00	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.08¼	.08
Barium selenite ($BaSeO_3$)	lb.	..	..
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk, f.o.b. shipping point,	ton	15.00-16.00	18.00
Bone ash	carlots, lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	..	.0355-.0425
Crystal	lb.	.028-.033	..
Granulated	lb.	.025-.03	..
Powdered	lb.	.02875-.03375	..
Boric acid (H_3BO_3)	lb.	.0625-.07125	.06-.08125
Refined	lb.	.0625-.07125	.07125-.08125
Cadmium sulphide (CdS)—			
Red	lb.	..	.80-1.00
Orange	lb.	..	.90-1.00
Yellow	lb.	..	1.40-1.65
Chromium oxide (Cr_2O_3)	lb.	.24	.24
Cobalt oxide (Co_3O_4)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.25
Black (CuO)	lb.	..	.23-.27
Black prepared	lb.	..	.22
Cryolite (Na_3AlF_6) Natural Greenland Kryolith)	lb.	.09	.10-.10½
Artificial or Chemical	lb.	..	.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.15-1.20
Feldspar—			
100 mesh	ton	12.50-20.00	13.50-22.00
80 mesh	ton	11.00-11.75	14.50
40 mesh	ton	11.00	13.50
Fluorspar (CaF_2) domestic, ground, 95-98% (max SiO_2, 2½%)			
Bulk, carloads, f.o.b. mines	ton	32.50	..
In bags or barrels	ton	36.50	41.50
Formaldehyde	lb.	..	.07½-.07¾
Graphite (C)	lb	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb	..	.0450
Black (FeO)	lb	.04½	..
Kaolin (f.o.b. mine)	ton	8.00-9.00	..
English, lump, f.o.b. New York	ton	14.50-25.00	24.50-30.00
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb	..	..
Lead oxide (Pb_3O_4) (red lead)	lb	.08	.09
Litharge (PbO)	lb.	.07	.08
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	10.50	..
Burnt (CaO) ground, in bulk	ton	7.00	..
Burnt, ground, in paper sacks	ton	9.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	2.30
Limestone ($CaCO_3$)		2.00-2.50	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.06	.07
light (in bbls.)	lb.	..	.23
extra light (in bbls.)	lb.	..	.27
Magnesium carbonate ($MgCO_3$)	lb.	.06	.07-.10½
Manganese 85% (MnO_2)	lb.	.03	.03
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	21.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.09	.09¼
Ground	lb	11	.12
Potassium carbonate—94-96%	lb.	.0555	.0555
Calcined (K_2CO_3) 96-98%	lb.	.06½	.07¼
Hydrated 80-85%	lb.	.05¾	.06¼
Potassium chromate (K_2CrO_4)	lb.	..	.23-.32
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.08
Potassium nitrate (KNO_3) (gran.)	lb.	..	.06½-.06¾
Potassium permanganate ($KMnO_4$)	lb.	.16	.17
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.19
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb	..	1.80-1.90
Silver nitrate ($AgNO_3$)	(100 oz.) per oz.	..	.27½
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.22½	..
In barrels	Per 100 lb.	1.55-1.57½	1.90-2.00
In bags	Per 100 lb.	1.37½-1.40	1.72½
Spot orders .025 per 100 lbs. higher		..	..
Sodium bichromate ($Na_2Cr_2O_7$)	lb	.07	.07½
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb.	2.95	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04½
95 per cent.	Per 100 lb.	1.95½-2.10	2.15-2.25
Sodium selenite (Na_2SeO_3)	lb.	..	2.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.50-1.55
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb	3.45	3.80-4.00
Flowers, in bags	Per 100 lb.	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.39	.37½
Tin oxide (SnO_2) in bbls.	lb.	..	.35-.38
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	..	2.75
Yellow	lb.	..	1.50
Zinc oxide (ZnO)	lb.	.08½	.12
American process, Bags	lb.	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude. Gran. (Milled .005-.02c higher)		.03½	.04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to August 25, 1930

	July 1929 Quantity	July 1929 Value	July 1930 Quantity	July 1930 Value	Seven Months Ending July 1929 Quantity	Seven Months Ending July 1929 Value	Seven Months Ending July 1930 Quantity	Seven Months Ending July 1930 Value
Glass and glass products (Total)	.....	$995,090	.....	$718,857	.....	$6,493,447	.....	$5,501,879
Plate and window glass—								
Window glass, common, box 50 sq. ft.	730	7,462	518	2,694	11,416	66,236	10,679	57,141
Plate glass, unsilvered, sq. ft.	100,318	38,945	355,287	112,682	1,254,516	443,740	2,145,894	653,781
Other window and plate glass lbs.	408,202	47,784	530,626	35,553	2,672,759	288,363	3,142,913	284,631
Glass containers (bottles, vials and jars)	.....	402,040	.....	253,731	.....	2,141,226	.....	1,760,303
Table glassware, plain	.....	113,238	.....	81,041	.....	876,914	.....	722,587
Table and other glassware, cut or engraved	.....	7,676	.....	4,593	.....	69,304	.....	54,215
Lamp chimneys and lantern globes lbs.	213,063	40,281	134,544	24,116	987,451	200,737	762,608	145,318
Globes and shades for lighting fixtures lbs.	180,986	62,936	113 790	41,373	1,232,809	448,619	1,031,205	369,891
Chemical glassware lbs.	24,618	22,022	20 041	18,977	143,519	129,900	140,325	131,537
Electrical glassware, except for lighting lbs.	246,118	25,935	120,091	9,086	3,713,210	290,510	2,800,308	182,706
Other glassware	.....	226,771	.....	135,011	.....	1,537,898	.....	1,139,769

IMPORTS

Corrected to August 25, 1930

Glass and glass products	.....	$1,358,072	.....	$615,394	.....	$8,063,813	.....	$5,233,392
Cylinder, crown and sheet—								
Plain dut. lb.	4,521,660	121,188	469,575	22,704	48,497,244	1,517,471	11,322,385	446,683
Bent, beveled, colored, etc. dut. lb.	.....	24,319	314,866	27,636	.....	353,938	314,866	227,226
Made into mirrors dut. sq. ft.	.....	.....	165	225	.....	.....	165	225
Plate glass—								
Plain dut. sq. ft.	940,695	188,834	232,079	47,874	6,250,194	1,330,146	2,916,535	605,247
Bent, beveled, colored, etc., and mirrors dut. sq. ft.	138,103	27,345	12,628	7,498	871,643	164,657	487,842	148,581
Rolled cylinder, crown, and sheet glass, ground, obscured, bent, beveled, colored, etc. dut. sq. ft.	.....	.....	.....	3,371	.....	.....	.....	5,673
Laminated and plated glass dut.	.....	.....	.....	2,797	.....	.....	.....	4,784
Bottles, vials, jars, and other containers dut.	.....	21,633	.....	67,938	.....	145,665	.....	767,325
Scientific articles and utensils dut.	.....	78,132	.....	40,655	.....	373,856	.....	338,853
Tubes and rods dut.	.....	.....	.....	6,975	.....	.....	.....	10,399
Illuminating articles dut.	.....	68,540	.....	41,278	.....	519,328	.....	368,037
Blown glass articles dut.	.....	641,462	.....	235,123	.....	2,652,590	.....	1,562,778
Pressed glass articles dut.	.....	33,381	.....	12,187	.....	164,051	.....	95,287
Other glassware dut.	.....	153,238	.....	99,133	.....	842,111	.....	652,294